

NUCLEAR SCIENCE ABSTRACTS

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ERRATA

NSA, Vol. 8, No. 7, p. Index-7. In Numerical Index of Reports, Report AECU-2177, availability information J. Cellular Comp. Physiol. 42, 327-39 should be J. Cellular Comp. Physiol. 42, 327-41(1953).

NSA, Vol. 8, No. 7, p. Index-8. In Numerical Index of Reports, Report AECU-2670, availability information Phys. Rev. 92, 687-93(1953) should be Univ. Microfilms (Ann Arbor, Mich.), Pub. No. 6061, 81 p. (Microfilm \$1.01, paper enlargement \$8.10).

NSA, Vol. 8, No. 7, p. Index-9. In Numerical Index of Reports, Report HW-29993, abstract number 8-1299 should be 8-1300.

NSA, Vol. 8, No. 7, p. Index-14. In Numerical Index of Reports, Report UCRL-2334, abstract number 8-1300 should be 8-1301.

NSA, Vol. 8, No. 7, p. Index-14. In Numerical Index of Reports, Report UR-289, abstract number 8-1301 should be 8-1302.

NSA, Vol. 8, No. 8, p. Index-6. Numerical Index of Reports, Report AECU-2176, abstract no. 6-556 should be 6-5556.

NSA, Vol. 8, No. 10, p. Index-1. In Numerical Index of Reports, Report AECU-2373, abstract number 7-6120 should be 7-6620.

NSA, Vol. 8, No. 11, p. Index-3. In Numerical Index of Reports, Report ORO-117, abstract number 8-3224 should be 8-3324.

GENERAL

ATOMIC POWER

5765

POWER COSTS: NUCLEAR VS COAL. *Nucleonics* 12, No. 8, 50-1(1954) Aug.

The average production cost of steam-generated electric power in the U. S. was computed to be 7.4 mills/kwh for the major utility systems. This cost is compared with the range of 4 to 7 mills/kwh sought from nuclear power plants. (C.H.)

RESEARCH PROGRAMS

5766

MAJOR ACTIVITIES IN THE ATOMIC ENERGY PROGRAMS JANUARY-JULY 1954. U. S. Atomic Energy Commission. Washington, D. C., U. S. Government Printing Office, July 1954, 137p. \$0.45.

The 16th semiannual report of the Atomic Energy Commission outlines progress and activities under the following headings: raw materials, production, construction and supply, military application, community operations, reactor development, physical research, biology and medicine, and organization and personnel. Several attached appendixes provide information on isotope distribution, AEC-owned patents, regulations governing radioisotope distribution and uranium leases on lands affected by federal mineral leasing laws, and an excerpt of a statement by the AEC on the probable course of industrial nuclear power development. (K.S.)

BIOLOGY AND MEDICINE

5767

Argonne Cancer Research Hospital
SEMIANNUAL REPORT TO THE ATOMIC ENERGY COMMISSION. Leon O. Jacobson, ed. Mar. 1954. 62p. Contract AT-(11-1)-69. (ACRH-1)

The rate of disappearance of Y^{90} from the pleural fluid and its distribution in the body of a patient 8 days after intrapleural administration are shown. Preliminary studies of the effect of cell suspensions on survival following irradiation showed that (1) a relatively small total number of cells is sufficient to insure significant survival when they are injected into mice that have been irradiated with 900 r and (2) embryo liver cells and baby mouse spleen or marrow cells are more effective than adult liver, spleen, or marrow cells. Survival, hematologic, and histologic studies have shown that (1) Pb-shielding of the surgically exteriorized spleen or appendix of rabbits during total-body exposure to 800 r of x radiation has a definite but minimal effect on the recovery of bone marrow and (2) recovery of the lymphatic

tissue of spleen-shielded or appendix-shielded rabbits is definitely more rapid than in irradiated-control animals, with recovery of appendix-shielded animals being more rapid than that of spleen-shielded animals. Results of a study of red cell survival times in patients suffering from liver diseases are summarized. Inoculation of irradiated pneumococci into normal mice and of irradiated *E. coli* into normal embryonated eggs failed to cause a demonstrable recovery of the irradiated bacteria. (A.G.W.)

5768

Argonne National Lab.
REPORT ON BIOLOGICAL, MEDICAL, AND BIOPHYSICS PROGRAM. PART 1. QUARTERLY REPORT OF BIOLOGICAL AND MEDICAL RESEARCH DIVISION. PART 2. SEMIANNUAL REPORT OF RADIOLOGICAL PHYSICS DIVISION. July 1954. 150p. Contract W-31-109-eng-38. (ANL-5288)

Part I. Progress is reported on the following studies: effects of radiation on ascites tumors in mice; effect of temperature of culture media on radiosensitivity of *Paramecium*; the role of hypotension in radiosensitivity of the chick; effect of radiation on the spleen in mice; calculation of the lethality function for exponentially decaying tritium; the effect of C^{14} irradiation on growth of soy beans; the appearance of tumors in mice used as control animals; bacteremia in irradiated mice; effects of variations in dosage rate of fast neutrons and γ radiation on survival in chicks; photoreactivation of *E. coli*; electron microscopic studies of fibrillogenesis; morphology of radiation-damaged leaves; kinetics of auxin action; mutants of *E. coli*; genetic variation in the radiosensitivity of mice; cation migration in paper electrochromatography; the analysis of mixtures of Sr^{89} and Sr^{90} ; radium metabolism in rats; the effect of streptomycin therapy on irradiated mice; metabolic requirements for the recovery of irradiated Tetrahymena; the protective effects of mouse serum, Cohn's blood protein fraction III, or protein fraction III plus cysteine against radiation injury in mice; toxicology of aurintricarboxylic acid in mice; a method for estimating total radiation dosage in a single chain, catenary system; the synthesis of labeled polycyclic compounds; the biosynthesis of C^{14} -labeled rubber in *Hevea brasiliensis*. Part II. Progress is reported in studies of fast neutron dosimetry and standardization of detection methods, development of a method for the determination of traces of RaTh in radium, and radium toxicity. Primary design requirements of an experimental meteorology stack are presented, and photographs are included. A two-camera photogrammetric technique for measuring the position of smoke or other variable tracers after their emission from the stack, and other instruments for use in stack disposal studies are described. (C.H.)

5769

Atomic Energy Project, Univ. of Calif., Los Angeles
STUDIES OF THE NEW HAMPSHIRE CHICKEN EMBRYO.
1. THE RED BLOOD CELL. George V. Alexander and

O. A. Schjeide. Aug. 13, 1954. 23p. Contract AT-04-1-GEN-12. (UCLA-301)

The number, size, volume, surface area, and types of red blood cells present at various stages of development of the embryo are described. (A.G.W.)

5770

Radiation Lab., Univ. of Calif., Berkeley
MEDICAL AND HEALTH PHYSICS QUARTERLY REPORT
[FOR] JANUARY, FEBRUARY, MARCH 1954. May 16, 1954.
60p. Contract W-7405-eng-48. (UCRL-2605)

The amounts of Ce^{144} , Pm^{147} , and Tb^{160} found in various organs and tissues of rats after given time intervals are tabulated. The acute and chronic effects of lethal amounts of I^{131} and At^{211} have been studied in the rat. A probit analysis for the mortality of I^{131} and At^{211} in the rat is presented. A limited number of uptake studies of At^{211} have been done with patients suffering from various disorders of the thyroid gland. There was no accumulation of At^{211} in a metastatic carcinoma of the thyroid gland. Data on the products of the heavy-particle irradiation of acetic acid and glycine are included. Measurements of three high-density lipoproteins in the serum of 566 clinically healthy adults have been made. Possible interrelationships in the serum levels of the three lipoproteins were evaluated. (For preceding period see UCRL-2553.) (A.G.W.)

5771

Atomic Energy Project, Univ. of Rochester
STUDY ON FLASH BURNS: EVALUATION OF SIMULTANEOUS MONITORING OF THE CARBON ARC SOURCE.
Kelly M. Berkley and Thomas P. Davis. July 1, 1954.
16p. Contract W-7401-eng-49. (UR-334)

A monitoring apparatus has been used with the carbon arc source in producing cutaneous burns in the pig. Its use in the evaluation of dose-effect experiments was tested by comparison of the 50% effective exposures for 1+, 2+, 3+, and 4+ burns when the irradiance value was determined (1) by the monitor response simultaneously with burning, and (2) by predetermined calibration curves of movable diaphragms along the optical bench of the carbon arc. It was found that there was no significant difference in the 50% effective exposure using either method of determining the irradiance value. It is concluded that the monitoring apparatus is not of practical value in evaluating radiant exposure-effect experiments. (auth)

5772

Atomic Energy Project, Univ. of Rochester
STUDY ON FLASH BURNS: THE INFLUENCE OF ULTRAVIOLET RADIATION ON THE PRODUCTION OF CUTANEOUS BURNS. Kelly M. Berkley. July 1, 1954. 17p. Contract W-7401-eng-49. (UR-335)

Radiant energy of wavelengths shorter than 3200 Å was excluded by Pyrex glass in producing cutaneous burns in the pig with the carbon arc source. The 50% effective exposures for burns so produced were compared with those exposures required with the carbon arc source alone at 0.5-sec exposure times. It was found that exclusion of the shorter ultraviolet wavelengths increased the 50% effective exposure of radiation required to produce 1+, 2+, 3+, and 4+ burns. Ultraviolet radiation had a most marked effect in producing erythema (1+ burn); the 50% effective exposure was increased two-fold with its exclusion. No effect was observed in the 50% effective exposure for the threshold of complete transepidermal damage judged by depth of damage microscopically produced with or without the short wavelength radiation. (auth)

5773

Atomic Energy Project, Univ. of Rochester
STUDY OF FLASH BURNS: THE EFFECT OF SPECTRAL DISTRIBUTION ON THE PRODUCTION OF CUTANEOUS BURNS. K. M. Berkeley, T. P. Davis, and H. E. Pearse. July 13, 1954. 25p. Contract W-7401-eng-49. (UR-336)

Radiation from the carbon arc, modified by four Corning glass filters with successive cut-off points separated by about 1500 Å, was used to produce cutaneous burns in pigs at a constant exposure time of 0.5 sec. It was found that the 50% effective exposures for 1+, 2+, and 3+ burns increased progressively with increase in wavelength. The effect of varying both spectral distribution and exposure times on the production of 2+ burns was also investigated. At 0.5 sec the requirements of radiant energy of wavelength greater than 6500 Å was 27% greater than that of wavelength greater than 3600 Å. At 2.0 and 4.0 sec it was 42% greater. The increase from 27% to 42% with increase of exposure from 0.5 to 2.0 or 4.0 sec is significantly different at the 0.95 level of confidence. This demonstrates a failure of reciprocity of time-intensity relationships of different magnitude with the two different filters in burn production. (auth)

5774

Atomic Energy Project, Univ. of Rochester
STUDY OF FLASH BURNS: EVALUATION OF SURFACE APPEARANCE OF BURNS BY DEPTH OF DAMAGE. K. M. Berkley. July 13, 1954. 16p. Contract W-7401-eng-49. (UR-337)

Burns produced on the pig by the carbon arc source alone and modified by two filters one eliminating all wavelengths below 3340 Å, the other below 6170 Å at exposure times of 0.5, 1.0, 2.0 and 4.0 sec were graded by surface appearance in the following manner. 1+ burns are erythematous lesions; 2+ burns show in the mildest form small spots of whiteness scattered over a red background. As the severity increases the spots become confluent. When an area of one cm^2 appears completely white, the laboratory grade of a 3+ burn is reached. Each grade of severity was further divided into mild, moderate, and severe subgroups. The burns were also evaluated histologically by depth of damage. It was found that a burn as judged by surface appearance in the grades of 1+ moderate to 3+ mild showed similar microscopic changes in each subgroup regardless of the exposure time or the wavelength distribution of energy used. A table is given which will serve as a guide to the depth of damage which will be found in a given burn when graded by its surface appearance for exposure times of 0.5 to 4.0 sec. (auth)

RADIATION EFFECTS

5775

Air Force Radiation Lab., Univ. of Chicago
QUARTERLY PROGRESS REPORT NO. 12. July 15, 1954.
125p. Contract AF-33(038)-27353. (NP-5266)

Progress is reported in studies of the protective effects of cysteine and mercaptoethylamine against radiation injuries; the effects of combinations of these drugs on enzyme activity and factors influencing enzyme activity in the hematopoietic tissues of irradiated animals; the effects of acute x irradiation on the alkaline phosphatase activity of the hematopoietic tissues of rats and mice; the effect of sublethal doses of whole body x irradiation on the total oxygen consumption of rat spleens and thymus glands in the presence of various substrates and after pretreatment

with *p*-aminopropiophenone; the effect of high-level x irradiation on biochemical constituents of rat tissues; modifications produced by *p*-aminopropiophenone on enzyme activity following total-body x irradiation of rats; the preparation of purified, concentrated mouse liver catalase and the tissue distribution of injected catalase in mice; the relationship of age, sex, and species to the radiation sensitivity of liver catalase; tests for the determination of hydroxyl radicals; sources of error in catalase assays; the possible importance of Fe in the radiation syndrome; a naturally occurring inhibitor of the enzyme hyaluronidase and its effect on response to whole-body x irradiation; the additive emetic action by apomorphine and whole-body x irradiation; and the effect of the temporal pattern of radiation exposure on biological response. (For preceding period see NP-5155.) (C.H.)

5776

Atomic Energy Medical Research Project, Western Reserve Univ.

SYNERGISTIC EFFECT OF RADIOISOTOPES USED IN COMBINATION. Paul R. Salerno and Hymer L. Friedell. Aug. 6, 1954. 39p. Contract W-31-109-eng-78. (NYO-4965)

The pattern of distribution of the radioactive elements was found to be the major determinant in the nature of the lethal action. It was found that small doses of a radioactive colloid such as Au^{198} or $\text{CrP}^{32}\text{O}_4$ would markedly sensitize rats or mice to the lethal action of Sr^{89} . Further experimentation revealed that the sensitizing action of the radio-colloids could be simulated by surgical splenectomy. The magnitude of the hematopoietic depression produced by bone-seeking internal emitters in normal and splenectomized animals paralleled the survival data. It followed that the spleen was the critical organ which can buffer the hematopoietic depression produced by a bone-seeking internal emitter. The capacity of the spleen to enhance survival was found to be virtually destroyed when rats or mice are exposed to total-body x irradiation in the lethal range. The severe radiation injury imposed upon the spleen by colloidal Au^{198} was found to be no more detrimental to survival than surgical splenectomy. It also emerged that the magnitude of the potentiated lethal action produced by either splenectomy or colloidal Au^{198} was more than twice as great in the mouse as in the rat. It is concluded that the marked capacity of the uninjured spleen to stimulate proliferative activity of the bone marrow is rather unique in the mouse and that extrapolation of data to other species must be supported by specific experimentation. (auth)

5777

Naval Radiological Defense Lab.

STUDIES ON THE EFFECT OF RADIATION PROTECTION FACTOR ON INCORPORATION OF FORMATE- C^{14} INTO NUCLEIC ACID PURINES IN X-IRRADIATED MICE. R. K. Main, L. J. Cole, and V. P. Bond. June 3, 1954. 31p. (USNRDL-444)

The *in vivo* inhibition, caused by whole-body x irradiation, of incorporation of formate- C^{14} into the nucleic acid purines (adenine and guanine) of bone marrow, small intestine, and spleen was investigated in LAF₁ mice. In bone marrow and in spleen this incorporation was markedly depressed by the 5th hour following irradiation. The incorporation approached zero by the 2nd post-irradiation day and remained so until the death of the animals. Less pronounced results were obtained from intestinal tissue.

It was demonstrated that treatment by a single immediate post-irradiation intraperitoneal injection of spleen homogenate (an agent post-protective against mortality) reversed the depression of incorporation of formate- C^{14} . Earliest reversal of inhibition by this treatment appeared by the 5th post-treatment day in the bone marrow and spleen DNA-adenine fractions. The factor or factors in spleen homogenate responsible for these effects are heat-labile. Under the experimental conditions used, the spleen homogenate preparation exerted no detectable effect on non-irradiated mice. (auth)

5778

A STUDY ON THE EFFECT OF S^{35} -LABELLED SODIUM SULPHATE ON FERTILITY IN MICE. Erik Odeblad and Harry Boström (Karolinska Institutet, Stockholm, Sweden). Acta Radiol. 41, 525-8(1954) June.

Groups of adult female mice were given amounts of S^{35} (sulfate) varying from 0.5 to 60 $\mu\text{C/g}$. The fertility in the various groups was tested by recording the percentage of pregnant animals and number of embryos per pregnancy. Even at the highest dosage levels studied, no complete inhibition of fertility occurred, and histologic damage of the ovaries was not observed with certainty. (auth)

5779

IMPROVED STORAGE QUALITY OF POTATO TUBERS AFTER EXPOSURE TO Co^{60} GAMMAS. A. H. Sparrow and E. Christensen (Brookhaven National Lab., Upton, N. Y.). Nucleonics 12, No. 8, 16-17(1954) Aug.

Gamma radiation, particularly from 5,000 to 20,000 r, can greatly prolong storage life of potatoes. Katahdin variety tubers were exposed to about 1,250, 5,000, 10,000, 20,000, 80,000, and 106,250 r, and effects on taste, sprouting, shrinkage, internal black spotting and texture were followed for 18 months. A taste panel preferred irradiated samples over controls after 8 months and found no undesirable taste in any irradiated samples even after 18 months' storage. Sprouting was reduced at the two lower dosages, completely inhibited at 20,000 r or higher. Weight loss during storage was greatly reduced at all but lowest dosage. After prolonged storage, lowest dosage sample and controls showed severe softening; highest doses produced some softening. Potatoes irradiated with 20,000 r were still firm and excellent in appearance after 18 months of storage. (auth)

5780

X RADIATION TELANGIECTASIA AS A LATE SYMPTOM. G. Miescher, J. Plüss, and B. Weder (Univ. of Zurich, Switzerland). Strahlentherapie 94, No. 2, 223-33(1954). (In German).

The results of re-checks are serving as a basis for an examination of the symptom of telangiectasia due to irradiation and its dependence upon the quality of the radiation, the dose and the time. It was found that it takes telangiectasias 5 years and more after the irradiation to completely develop, that, with respect to this symptom, no differences exist between soft and hard rays, and that the predisposition of the skin of the trunk and the extremities toward telangiectasias is considerably greater than that of the skin of the face. (auth)

5781

LETHAL DOSE STUDIES WITH BURROS AND SWINE EXPOSED TO WHOLE BODY COBALT-60 IRRADIATION. John H. Rust, Bernard F. Trum, James L. Wilding, Charles S. Simons, and C. L. Comar (Univ. of Tennessee, AEC Agri-

cultural Research Program, Oak Ridge). *Radiology* 62, 569-74(1954) Apr.

The $LD_{50/30}$ for sexually mature burros exposed to whole-body Co^{60} γ rays in a specially constructed exposure field at about 51 r/hr was estimated to be 784 r with a 95% confidence interval of 753 to 847 r. The $LD_{50/30}$ for swine exposed to Co^{60} γ rays at about 50 r/hr was estimated to be 618 r with a 95% confidence interval of 526 to 682 r. Burros exposed to Co^{60} had a significantly higher $LD_{50/30}$ than did those exposed to Ta^{182} . Phantom studies were made with a water-filled Lucite phantom. It was found that $67.8 \pm 1.6\%$ of the entering dose could be measured at a point 19.5 cm from the lateral wall when all 19 radioactive sources were contributing to the flux of the field. (A.G.W.)

RADIATION HAZARDS AND PROTECTION

5782

Atomic Energy Medical Research Project, Western Reserve Univ.

A COMPARISON OF THE MAGNITUDE OF CYSTEINE ANTAGONISM TOWARD SMALL AND LARGE DOSES OF X-IRRADIATION. Paul R. Salerno and Hymer L. Friedell. June 28, 1954. 11p. Contract W31-109-eng-78. (NYO-4963)

Au^{198} and P^{32} in combination with x irradiation were used to compare the magnitude of the prophylactic effect of cysteine against doses of 393 r to 786 r of x rays in rats. Cysteine-free base in neutral aqueous solution was injected intraperitoneally at a dose of 800 mg/kg 15 to 20 minutes before exposure to x radiation. Exposure to sub-lethal doses of x irradiation before treatment with cysteine and varying doses of x ray was also used as a method to measure the magnitude of the protective action of cysteine against several doses of x ray. Cysteine was shown to be more effective against large doses than against small doses of x irradiation. It was found that approximately one-third to one-half of the biological effect of x irradiation irrespective of the dose in r is antagonized by a given dose (800 mg/kg) of cysteine. (auth)

5783

Atomic Energy Medical Research Project, Western Reserve Univ.

COMPARISON OF THE PROTECTIVE EFFECTS OF D AND L ISOMERS OF CYSTEINE AGAINST TOTAL BODY RADIATION AND NITROGEN MUSTARD IN RATS. J. P. Storaasli, S. Rosenberg, and A. Weisberger. Aug. 6, 1954. 12p. Contract W31-109-eng-78. (NYO-4967)

D-Cysteine is comparable to L-cysteine in its ability to reduce the lethal effects of total-body radiation and nitrogen mustard in rats. This is of interest since the D isomer can not be utilized in protein synthesis without first being converted to L-cysteine. This would seem to indicate that cysteine protection is on a nonspecific basis. There appears to be more protection against the neutropenia produced by NH_2 with L-cysteine than with D-cysteine. The reasons for this are obscure at the present time. (auth)

5784

HOW IMPORTANT IS SURFACE CONTAMINATION? Merrill Eisenbud, Hanson Blatz, and Eugene V. Barry (AEC Health and Safety Lab., New York). *Nucleonics* 12, No. 8, 12-15 (1954) Aug.

A survey of radium and uranium plants shows that surface monitoring is less indicative of personnel hazard

than air sampling and bioassay. Costly surface decontamination is unnecessary unless warranted by effects on airborne dust or external radiation. (auth)

5785

INVESTIGATIONS OF BIOLOGICAL RADIATION PROTECTION. VI. ON THE MORTALITY OF X-IRRADIATED MICE, THE DIFFERENCE BETWEEN SEXES AND THE INFLUENCE OF THE GONADS OF RADIOSENSITIVITY. H. Langendorff and R. Koch (Univ. of Freiburg, Germany). *Strahlentherapie* 94, No. 2, 250-7(1954). (In German)

The curve representing the dose effect of roentgen irradiations on male and female mice reveals a greater sensitivity of the male animals as compared to the female animals. After castration, the females are more sensitive and the males much less sensitive. After administration of testosterone, the radioresistance of female mice increases far beyond the norm. Oestradiol does not influence the radiosensitivity of castrated male mice. (auth)

5786

THE EFFECT OF 1,4-DIMETHYL-7-ISOPROPYLAZULENE AGAINST RADIATION DAMAGE FROM X-RAY THERAPY. K. L. Schmidt (St. Markus-Krankenhaus, Frankfurt a. M., Germany). *Strahlentherapie* 94, No. 2, 270-1(1954). (In German).

Sufficiently large doses of 1,4-dimethyl-7-isopropylazulene will often effectively combat the side effects of deep x-ray therapy and permit the completion of the treatment despite the beginning discomfort of the patient. (J.S.R.)

RADIOTHERAPY

5787

THE GAMMA-RAY DOSE IN CARCINOMA OF THE THYROID TREATED BY RADIO-IODINE. A. F. Phillips (Univ. of Cambridge, England). *Acta Radiol.* 41, 533-44(1954) June.

The irregular distribution of radioactive iodine taken up by carcinoma of the thyroid, and the short range of the beta-rays emitted by I^{131} , appear likely to leave certain regions of the tumors virtually unirradiated by these rays. The dose of radiation in such regions due to the gamma-rays from I^{131} has been measured in operation specimens from two cases, and was found to be of the same order of magnitude as the dose calculated for uniform distribution of the radioactivity. Malignant cells were present in some of the regions of low activity. In general it may be impossible to give large enough gamma-ray doses by means of I^{131} to effect a cure. Other radioactive isotopes of iodine may prove more useful in the treatment of carcinoma of the thyroid. (auth)

5788

AVAILABLE Co^{60} SOURCE FOR TELETHERAPY. Marshall Brucer (Oak Ridge Inst. of Nuclear Studies, Tenn.). *Nucleonics* 12, No. 8, 45-6(1954) Aug.

A double-overlapping-cloverleaf source was designed to make maximum use of the cobalt-60 currently in plentiful supply from one of the Oak Ridge facilities. This source material is now available as 1-cm-diameter and 0.32-cm-diameter rods in lengths up to 4 cm and with specific activities ranging from 7 to 11 curies/gm. (C.H.)

5789

SKIN DOSE FROM A COBALT 60 TELETHERAPY UNIT. Jasper E. Richardson, Herbert D. Kerman, and Marshall

Brucer (Oak Ridge Inst. of Nuclear Studies, Tenn.).
Radiology 63, 25-36(1954) July.

The skin dose from a cobalt 60 teletherapy unit has been studied for different conditions of irradiation. For short cone-to-skin distances, electrons from the collimating system contaminate the beam and result in an appreciable skin dose. The expectations that a material of intermediate atomic number would prove superior as an inner lining and as a filter to remove secondary radiation were confirmed. For cone-to-skin distances greater than 20 cm, an electron filter is not needed. Between 4 cm and 20 cm cone-to-skin distance, the skin dose is reduced appreciably if an electron filter is used. At these distances, both intermediate and high Z materials were found to be superior to those of low atomic number, although there was little difference between the results obtained with filters of intermediate and high Z materials. For cone-to-skin distances between 0 cm and 4 cm, optimum results were obtained with a filter material of intermediate atomic number. The difference between intermediate and high Z materials was most significant at 0 cm cone-to-skin distance. (auth)

TOXICOLOGY STUDIES

5790

Atomic Energy Project, Univ. of Rochester
TOXICOLOGY OF THE ORGANIC PHOSPHATE ESTERS.
Frances Haven and Kenneth Lauterbach. July 2, 1954. 37p.
Contract W-7401-eng-49. (UR-342)

Acute toxicity data (LD_{50} 's) and references to the literature are given for alkyl phosphates, alkyl thiophosphates, alkyl pyrophosphates, alkyl thiopyrophosphates, and amidophosphates. These classes contain a total of 45 chemical compounds with the structural formula for each. Species include the mouse, the rat, and the rabbit. Data for chronic toxicity by ingestion are given for parathion and for two relatively new phosphate esters. A comparison of the LD_{50} 's for closely similar compounds suggests eight alterations in chemical structure which may decrease the acute toxicity of the organic phosphate esters. Examples and references are given. The section on the mechanism of poisoning includes cholinesterase inhibition *in vitro* and *in vivo*, the relation of chemical structure, the fate of organic phosphates within the body, and the specific effects of certain of these compounds on the central nervous system. The unusual properties of the phosphoramidate compounds, which are specific for peripheral tissues rather than for the brain, are considered in a separate section. The advantages and limitations of atropine in the prophylaxis and therapy and as an antidote in poisoning by organic phosphate esters are given. Other drugs of limited usefulness as prophylactic agents or as antidotes in animal experiments are mentioned. (auth)

TRACER APPLICATIONS

5791

Atomic Energy Project, Univ. of Rochester
IN VIVO LOCALIZATION OF LABELED RAT ADRENAL ANTIBODIES. Irving L. Spar and William F. Bale. June 16, 1954. 15p. Contract W-7401-eng-49. (UR-332)

After intravenous injection in rats the degree of localization of I^{131} -labeled antibodies against rat adrenal tissue was measured in thirteen rat organs or tissues. Production of antibodies had been induced in rabbits by intramuscular injection of rat adrenal as an antigen. The labeled antibodies, after intravenous injection, localize strongly in rat adrenal tissue, less strongly but significantly in ovarian, kidney,

spleen, and liver tissue, and almost not at all in the other major body organs and tissues measured. Radioautographs indicated that localization in the adrenal was greatest in the zona reticularis, and in the kidney in the glomeruli. The results suggest that an *in vivo* localization and reaction with adrenal tissue of autoantibodies produced against the adrenal and perhaps other tissues may sometimes be a factor in endocrine malfunction. The results are also discussed with regard to the possible use of antibodies as carriers of radioactive or high neutron cross section isotopes for therapeutic purposes. (auth)

5792

PROCEDURE FOR DIGESTION AND RADIOASSAY OF ANIMAL TISSUES. Herman Cember, Joseph A. Watson, and Thomas B. Grucci (Univ. of Pittsburgh, Penna.).
Nucleonics 12, No. 8, 40-1(1954) Aug.

5793

THE METABOLISM OF NICKEL. I. SPATIAL AND TEMPORAL DISTRIBUTION OF Ni^{63} IN THE MOUSE. Arthur W. Wase, Donald M. Goss, and M. John Boyd (Hahnemann Medical Coll., Philadelphia). *Arch. Biochem. and Biophys.* 51, 1-4(1954) July.

Administered Ni^{63++} is widely distributed throughout the tissues and organs of the mouse. It is rapidly metabolized by the principal tissues with the exception of the lung and brain. It is eliminated via the feces and urine shortly after administration. (auth)

5794

OBSERVATIONS ON Δ^7 -CHOLESTENOL METABOLISM IN THE RABBIT. Max W. Biggs, Richard M. Lemmon, and Frank T. Pierce, Jr. (Univ. of Calif., Berkeley). *Arch. Biochem. and Biophys.* 51, 155-60(1954) July.

Tritium-labeled sterol Δ^7 appears in the free and total cholesterol pools of the serum of the rabbit following tritium-labeled Δ^7 -cholesterol feedings in a manner qualitatively similar to that occurring following tritium-labeled cholesterol feedings. The conversion of Δ^7 -cholesterol to cholesterol has been demonstrated. Tritium-labeled cholesterol was isolated from the liver sterols of rabbits fed tritium-labeled Δ^7 -cholesterol. (auth)

WASTE DISPOSAL

5795

DISTRIBUTION OF RADIOISOTOPES IN COLUMBIA RIVER. Richard F. Foster and Royal E. Rostenbach (General Electric Co., Richland, Wash.). *J. Am. Water Works Assoc.* 46, 633-40(1954) July.

The distribution of radioactive material in Columbia River water and aquatic life at several areas above and below the point at which reactor cooling water is discharged has been analyzed. A hydrological and ecological summary of the Columbia river basin forms an introduction to the discussion. It is stated that maximum radioactivity levels are well below $1/10$ of the recommended maximum permissible concentration. (K.S.)

CHEMISTRY

5796

Eclipse-Pioneer Div., Bendix Aviation Corp.
BIBLIOGRAPHY AND SOURCE MATERIAL ON NITRIC ACID, WITH EMPHASIS ON ITS USE AS AN OXIDIZER

FOR ROCKET FUELS. REPORT NO. 515-801. K. Elsas. Dec. 31, 1951. 36p. Contract W-30-069-ORD-4450. (ATTI-129118)

This bibliography of 188 references compiled from published literature gives material on the properties of HNO_3 , its preparation and decomposition, phase relationships in HNO_3 systems, properties of nitrogen oxides, decomposition of N_2O_5 and NO , kinetics of N_2O_4 and NO_2 , and decomposition of HNO_2 . A brief summary is given when the title of the article is not definitive. (J.S.R.)

5797

METHYLAL AS A SOLVENT IN LITHIUM ALUMINIUM HYDRIDE REDUCTIONS. Erling Bernatek (Universitetets Kjemiske Institutt, Blindern-Oslo, Norway). *Acta Chem. Scand.* 8, No. 5, 874-5(1954).

The low boiling point of methylal was found to allow the rapid removal of the solvent from the products and to make it less apt to cause rearrangements. As a solvent it is superior to diethyl ether in that it dissolves to an appreciable extent polycarboxylic acids and polycarbonyl compounds. Glycols and other polyhydric alcohols are also found to be more soluble in methylal than in ether. (auth)

5798

HYDROCARBON PRODUCTS FROM THE REACTIONS OF METHYLLITHIUM AND ETHYLMAGNESIUM BROMIDE WITH METAL SALTS. Henry Gilman, Reuben G. Jones, and L. A. Woods (Iowa State Coll., Ames). *J. Am. Chem. Soc.* 76, 3615-17(1954) July 20.

The hydrocarbon products from reactions of certain heavy metal salts with methyllithium were found to be methane and ethane in various proportions depending on the metal. Ethylmagnesium bromide reacted with the heavy metal salts to form ethane, ethylene and, in some cases, butane. The reactions have been interpreted as involving the intermediate formation of unstable organometallic compounds. (auth)

5799

HEATS OF FORMATION OF NICKEL AND COBALT OXIDES (NiO AND CoO) OF COMBUSTION CALORIMETRY. B. J. Boyle, E. G. King, and K. C. Conway (Bureau of Mines, Region III, Berkeley, Calif.). *J. Am. Chem. Soc.* 76, 3835-7(1954) July 20.

The heats of formation of nickel and cobalt oxides (NiO and CoO) were determined as $\Delta H_{298.16} = -57.3 \pm 0.1$ and $\Delta H_{298.16} = -57.1 \pm 0.3$ kcal/mole, respectively, by combustion calorimetry. The corresponding free energies of formation from the elements are -50.6 and -50.4 kcal/mole. (auth)

5800

POTASSIUM, RUBIDIUM AND CESIUM BOROHYDRIDES. M. Douglas Banus, Robert W. Bragdon, and Alfred A. Hinckley (Metal Hydrides, Inc., Beverly, Mass.). *J. Am. Chem. Soc.* 76, 3848-9(1954) July 20.

KBH_4 , RbBH_4 , and CsBH_4 can be prepared by the reaction of NaBH_4 with an alkali solution. The hygroscopicity, solubility, and thermal stability of KBH_4 were determined. The density, refractive indices, and x-ray-powder patterns of the three borohydrides are tabulated. (J.S.R.)

5801

ISOTOPIC EXCHANGE REACTIONS IN TRIETHYLAMINE-LIQUID SULFUR DIOXIDE SOLUTIONS. Rolfe H. Herber and T. H. Norris (Oregon State Coll., Corvallis). *J. Am. Chem. Soc.* 76, 3849-50(1954) July 20.

In agreement with previous results a yellow-orange viscous addition compound which solidified at low temperatures

was formed by the reaction between triethylamine and SO_2 . The monohydrate (m.p. 70 to 80°) was formed when water was added. The exchange rate of sulfur between the addition compound and SO_2 was rapid and complete even at dry ice temperatures. (J.S.R.)

5802

CHLORINE ISOTOPE EFFECT. Rosalie M. Bartholomew, F. Brown, and M. Lounsbury (Atomic Energy of Canada Ltd., Chalk River, Ontario). *Nature* 174, 133(1954) July 17.

The isotope effect on reaction rates was shown for Cl^{35} and Cl^{37} by the reaction of t-butyl chloride with AgNO_3 in 98% alcohol at room temperature. It was found that the Cl^{35} compound reacted faster than the Cl^{37} compound. The relative rates of reaction k^{35}/k^{37} were calculated by two measurements to be 1.007 ± 0.003 and 1.008 ± 0.001 . (J.S.R.)

ANALYTICAL PROCEDURES

5803

THE SEPARATION OF LANTHANUM AND ACTINIUM BY CONTINUOUS PAPER ELECTROPHORESIS. Michael Lederer (Institut du Radium, Paris, France). *Anal. Chim. Acta* 11, 145-8(1954) Aug. (In English)

A method has been worked out for the separation of La-Ac mixtures and certain rare earth mixtures by continuous electrophoresis on paper sheets using 1% citric acid as electrolyte and a potential of 300 v. (auth)

FLUORINE AND FLUORINE COMPOUNDS

5804

THE IONIZATION CONSTANTS OF SOME NEW FLUORINE-CONTAINING ACIDS. E. T. McBee, O. R. Pierce, and D. D. Smith (Purdue Univ., Lafayette, Ind.). *J. Am. Chem. Soc.* 76, 3722-5(1954) July 20.

The acids $\text{CF}_3\text{CH} = \text{CHCO}_2\text{H}$ and $\text{C}_3\text{F}_7\text{CH} = \text{CHCO}_2\text{H}$ are stronger than $\text{CF}_3\text{CH}_2\text{CH}_2\text{CO}_2\text{H}$ and $\text{C}_3\text{F}_7\text{CH}_2\text{CH}_2\text{CO}_2\text{H}$; and considerably stronger than their non-fluorinated analogs, but they are much weaker acids than $\text{CF}_3\text{CO}_2\text{H}$ or $\text{C}_3\text{F}_7\text{CO}_2\text{H}$. Thus it is shown that the inductive effect of fluorine in the CF_3 - and C_3F_7 - groups is transmitted only partially through a vinyl group. (auth)

5805

THE PREPARATION AND PROPERTIES OF SOME COMPOUNDS CONTAINING THE 4,4,4-TRIFLUOROCROTYL GROUP. E. T. McBee, O. R. Pierce, and D. D. Smith (Purdue Univ., Lafayette, Ind.). *J. Am. Chem. Soc.* 76, 3725-8(1954) July 20.

The preparation and reactions of several compounds containing the 4,4,4-trifluorocrotyl group are described, and an unusual reaction of lithium aluminum hydride—the reduction of an α,β -dibromoester to an α,β -unsaturated alcohol at ca. -80°—is reported. (auth)

5806

STRUCTURES OF COMPLEX FLUORIDES. THE STRUCTURE OF SODIUM OCTAFLUOTANTALATE Na_3TaF_8 . J. L. Hoard, W. J. Martin, M. E. Smith, and J. F. Whitney (Cornell Univ., Ithaca, N. Y.). *J. Am. Chem. Soc.* 76, 3820-3(1954) July 20.

Sodium fluotantalate crystallizes in a four-molecule monoclinic unit having $a = 11.52$, $b = 5.38$, $c = 11.21$ Å, $\beta = 120^\circ 55'$, and the space group $C_{2h}^6 - C2/c$. Scattering by tantalum dominates the diffraction intensities and greatly facilitates the determination of structure while severely limiting the accuracy with which fluorine and sodium positions can be

fixed. The structure is a salt-like aggregate of sodium and complex TaF_6^{-3} ions. Within the estimated accuracy of the determination the TaF_6^{-3} ion in the crystal could have exactly the configuration of the square Archimedean antiprism of symmetry D_{4d} -82m. However, the most probable configuration for the anion shows some departure from the ideal shape, presumably in consequence of somewhat less than ideal packing relations in the crystals. (auth)

5807

ANHYDROUS HYDROGEN FLUORIDE AS A SOLVENT FOR PROTEINS AND SOME OTHER BIOLOGICALLY IMPORTANT SUBSTANCES. Joseph J. Katz (Argonne National Lab., Lemont, Ill.). Arch. Biochem. and Biophys. 51, 293-305(1954) July.

Anhydrous fluoride has been shown to be a powerful solvent for a wide variety of proteins as well as a number of other biologically important substances such as chlorophyll and vitamin B_{12} . Both insulin and ACTH have been recovered from hydrogen fluoride solution with retention of their biological properties. This suggests that this new solvent may have real significance in the study of the chemical and physical properties of proteins. (auth)

GRAPHITE

5808

[Chicago Univ.]

PROGRESS REPORT [ON THE STRUCTURE AND PROPERTIES OF GRAPHITE]. [1954] 12p. Contract AT-(11-1)-96. (COO-151)

Further steps in the investigation on the energy exchange between a hot graphite surface and relatively cold molecules of hydrocarbons are reported. The design of a device which keeps the graphite filament at a constant resistance to 1×10^4 and records the necessary current on a Brown recorder is presented. In this way it is possible to follow the changes in the heat losses of the filament to the surrounding gas due to conduction and/or decomposition reaction with a very short response. The effects of nature and pressure of surrounding gases on the electrical resistance of graphite filaments and on annealed filaments as a function of temperature are discussed. Pressures from 2,000 to 55,000 atm applied to hexagonal graphite single crystals indicated that associated gliding movements are needed to transform the crystals to the rhombohedral structure. X-ray investigations showed mechanical twinning is not related to the formation of the rhombohedral structure. Heating of the crystals at $3,000^\circ\text{C}$ for 20 min in A and $1,500^\circ\text{C}$ for 4 hr in a vacuum furnace completely erased the rhombohedral modification. (For preceding period see COO-150.) (J.A.G.)

5809

X-RAY DIFFRACTION STUDIES ON CARBON GASIFICATION. P. L. Walker, Jr., H. A. McKinstry, and J. V. Pustinger (Pennsylvania State Univ., State College.) Ind. Eng. Chem. 46, 1651-8(1954) Aug.

An investigation of possible changes in interlayer spacing, average crystallite size, and intensity of x-ray diffraction peaks of an artificial graphite before and after various stages of gasification with carbon dioxide is presented. Upon gasification the interlayer spacing of the residual carbon decreases, the average crystallite size increases, and the ratio of intensities of the (002) to the (100) x-ray diffraction peak increases. These results all suggest that

upon gasification the less graphitic carbon is, at least in part, preferentially reacted. The results also explain why the strength of graphite electrodes sometimes rapidly decreases with use. The almost complete reacting away of the binder material, even at low weight losses of carbon, substantially weakens the cohesion between particles and, hence, the strength of the solid structure. (auth)

MOLECULAR STRUCTURE

5810

National Bureau of Standards

ELECTRONIC STRUCTURE OF STABLE PENTABORANE. Merrill B. Wallenstein. June 30, 1954. 13p. (NBS-3454)

A discussion of the electronic structure of stable pentaborane is presented. The assignment of orbitals given is based on the proposal that the bridge structures in the boron hydrides be considered as a single bond having essentially the same characteristics as the usual two-center bond. The symmetry group for this molecule is C_{4v} , and the orbital assignment deduced is $[(a_1)^2(b_2)^2(e)^4; B-H] [(a_1)^2(b_1)^2(e)^4; B-H-B] [(a_1)^2(e)^4; B-B]; {}^1A_1$, where the first set of orbitals are those responsible for B-H bonding, the second for B-H-B bonding, and the third for the boron framework bonding. (auth)

5811

National Bureau of Standards

BOND ENERGIES AND HEATS OF FORMATION OF SOME BORON COMPOUNDS. Merrill B. Wallenstein and Edward J. Prosen. June 30, 1954. 19p. (NBS-3455)

The heats of formation of some boron compounds have been used to derive average bond energies. These are then used to estimate the heats of formation of tetraborane and several alkyl-substituted diboranes. Calculations based on these bond energies indicate the energy of the B-N-B bridge bond to be about 70 kcal, thus indicating this bridge to be of the same three-center, two-electron nature as the B-H-B bridge bond. The heat of formation of BF_3CO is also estimated. (auth)

RADIATION CHEMISTRY

5812

Brookhaven National Lab.

PROGRESS REPORT ON FISSION PRODUCTS UTILIZATION. 6. FURTHER STUDIES OF THE EFFECT OF GAMMA RADIATION ON VINYL POLYMER SYSTEM. D. S. Ballantine. Mar. 1954. 21p. (BNL-294)

The initiation of polymerization by gamma radiation has been extended to emulsions of styrene at various temperatures. The rates are faster and molecular weights higher than those obtained in bulk polymerizations at similar temperatures. The monomer N-vinylpyrrolidone has been polymerized in aqueous solutions under varying conditions of intensity, temperature, and solvent composition. The polymer is manufactured under the name "Plasdone" and is used as a blood plasma substitute. Data on rate and K value (an empirical index of molecular weight) are given. A series of perfluoromonomers were irradiated in an attempt to cause polymerization, but the rates observed were extremely low as was the molecular weight of the polymer produced. Acrylamide, a monomer with melting point of 84.5°C , has been polymerized in the solid state by means of gamma rays. Rate and molecular weight data from experiments at various intensities and temperatures are reported.

Commercial polyethylene films and rods have been irradiated with gamma rays, and quantitative measurements of the physical properties such as tensile strength, creep, and heat deformation made. In general, radiation produces an improvement in heat stability but deleteriously affects tensile and elastic properties. (For preceding report in series see BNL-229.) (auth)

5813

PROPERTIES OF IRRADIATED POLYETHYLENE. EFFECT OF INITIAL MOLECULAR WEIGHT. Elliott J. Lawton, J. S. Balwit, and A. M. Bueche (General Electric Co., Schenectady, N. Y.). *Ind. Eng. Chem.* 46, 1703-9(1954) Aug.

Polyethylene is cross-linked when irradiated with high energy electrons. The physical properties of irradiated polyethylene were measured to determine the magnitude of the changes brought about by irradiation with high-energy electrons and the efficiency of the electrons in the cross-linking process. Polyethylene irradiated with 800-kv (peak) electrons was investigated over a wide temperature range. The molecular weight range covered was from 7000 to 35,000 for irradiation doses up to 200×10^6 roentgen units. The improvements in tensile strength, elongation at break, and tension set were found to be dependent upon the initial molecular weight of the polymers and the total irradiation dose—a dose of 15×10^6 roentgens increased the tensile strength of a polyethylene of molecular weight 21,000 from 2100 to 3320 psi, equivalent to an effective molecular weight increase of about 4000. Above the melting temperature for the unirradiated material, the irradiated polyethylene behaved as a noncrystalline cross-linked elastomer. The efficiency for cross-linking was found to depend upon the initial molecular weight and the irradiation dose. The improvement in physical properties can be explained in terms of decreasing crystallinity and increasing cross-linking during the irradiation. The irradiation of polyethylene by high-energy electrons can be used to give a cross-linked polymer having improved physical properties and high-temperature characteristics over those of the original material. This irradiated polyethylene could find application where requirements are too severe for the normal polyethylene. (auth)

RARE EARTHS AND RARE-EARTH COMPOUNDS

5814

PRASEODYMIUM OXIDES. I. PHASE STUDY BY DISSOCIATION PRESSURE MEASUREMENTS. R. E. Ferguson, E. Daniel Guth, and L. Eyring (State Univ. of Iowa, Iowa City). *J. Am. Chem. Soc.* 76, 3890-4(1954) Aug. 5.

A phase study of the praseodymium oxide system in the composition range Pr_2O_3 to Pr_6O_{11} has been made by an equilibrium dissociation pressure method involving the construction of isothermal (equilibrium oxygen pressure vs. composition of oxide) curves. The pressure-composition diagram is interpreted as indicating the existence of four separate non-stoichiometric regions in the range Pr_2O_3 to Pr_6O_{11} , and the existence of five stable phases, or regions of stability, in the same range. Conditions for the existence of the various phases are discussed qualitatively in terms of the theory of non-stoichiometric compounds. (auth)

5815

PREPARATION AND PROPERTIES OF THE RARE EARTH FLUORIDES AND OXYFLUORIDES. Alexander I. Popov and George E. Knudson (State Univ. of Iowa, Iowa City). *J. Am. Chem. Soc.* 76, 3921-2(1954) Aug. 5.

The rare earth oxides were reacted with dry ClF_3 at room temperature. Only Gd_2O_3 was appreciably converted to the fluoride. The addition of moisture to the oxides resulted in the complete fluorination of the lighter rare earth oxides, from La through Sm. The intermediate oxides (Eu_2O_3 to Er_2O_3) showed partial fluorination, but Tm, Yb, and Lu did not react at all. The hydrolysis of the rare earth fluorides in air at 800° resulted in the formation of the oxyfluoride, and, if the hydrolysis was continued, the oxide. Some of the chemical properties of the fluorides and oxyfluorides were determined. (J.S.R.)

SEPARATION PROCEDURES

5816

Wisconsin Univ.

[CHEMISTRY OF HAFNIUM AND ZIRCONIUM]. TECHNICAL REPORT NO. 6. THE ION EXCHANGE OF ZIRCONIUM AND HAFNIUM IN PERCHLORIC ACID WITH AMBERLITE IR-120. Edwin M. Larsen and Pei Wang. Aug. 5, 1954. 29p. Contract N7onr 28504, T. O. 4. (NP-5289)

Batch experiments with zirconium-hafnium perchlorate solutions and Amberlite IR-120 were made over total metal ion concentrations of 1×10^{-2} to 1×10^{-6} molar and at 2M, 1M, and 0.5M perchloric acid at constant ionic strength of 2. The data show that the metal ions are hydrolyzed in the resin phase. The data can be interpreted in terms of unhydrolyzed metal species M^{4+} in the aqueous phase at 1 and 2M hydrogen ion. The distribution data show that zirconium is favored over hafnium in the resin phase, with the ratio of the distribution coefficients, $D_{\text{Zr}}/D_{\text{Hf}}$, increasing in favor of zirconium at the lower aqueous hydrogen ion concentration. At high total metal ion concentration, the hafnium appears to enter into mixed zirconium-hafnium polymers at hafnium concentrations considerably below that at which the hafnium polymer formation alone would be significant. (For preceding report in series see NP-4760.) (auth)

5817

Clarkson College of Tech.

PERFORMANCE OF PACKED COLUMNS. PART 3. HOLDUPS FOR AQUEOUS AND NONAQUEOUS SYSTEMS. H. L. Shulman, C. F. Ullrich, N. Wells, and A. Z. Proulx. Aug. 10, 1954. 43p. Contract AT(30-1)-1463. (NYO-6098)

Total, static, and operating holdups have been measured for 1-in. porcelain and carbon Raschig rings and 1-in. porcelain Berl saddles, employing aqueous solutions of calcium chloride, sorbitol, and a wetting agent as well as pure methanol and benzene. The range of variables covered by this investigation includes liquid rate, 1,000 to 10,000 lbs/(hr)(ft²); viscosity, 0.6 to 185 cp; surface tension, 23 to 86 dynes/cm; and specific gravity, 0.8 to 1.32. Equations and charts are presented for estimating holdups for all liquids. The application of holdups for estimating mass transfer coefficients, k_G , and effective interfacial areas, a , are discussed. The total holdups for water, methanol, and benzene can be used to explain why mass transfer coefficients obtained by vaporization of pure liquids in packings seem to depend on gas diffusivity raised to the 0.15 power instead of the 0.67 power as found in other mass transfer studies. The larger total holdups of nonaqueous liquids result in larger effective interfacial areas in the packing which mask the effect of the change in gas diffusivity. (For first two parts see NYO-6096 and NYO-6097.) (auth)

5818

ON A PHENOMENON OF ISOTOPE SEPARATION IN-

DUCED BY THE PASSAGE OF ELECTRIC CURRENT IN A LIQUID METAL. Guy Nief and Étienne Roth. *Compt. rend.* 239, 162-4(1954) July 12. (In French).

The isotopes Ga^{69} and Ga^{71} were concentrated at the anode and cathode of a 0.2-mm capillary, 18-cm long, containing pure Ga. An electric current of 1.5 to 2.5 amp was passed through the column for 10 days, and concentration constants were obtained at each electrode which indicated a definite tendency for isotope separation (K.S.)

SPECTROSCOPY

5819

Ames Lab.

THE INFRARED SPECTRA OF AROMATIC COMPOUNDS.

1. THE OUT-OF-PLANE C-H BENDING VIBRATIONS IN THE REGION $625\text{--}900\text{ cm}^{-1}$. M. Margoshes and V. A. Fassel. July 12, 1954. 21p. Contract W-7405-eng-82. (ISC-502)

An empirical study was made of the infrared spectra of aromatic compounds to determine the effect of substituent groups on some of the vibrations of the aromatic nucleus. Particular attention is devoted to the out-of-plane C-H bending vibrations between 625 and 900 cm^{-1} . For monosubstituted benzenes of the type $(\text{phenyl})_n\text{M}$, where n is the valence of the substituent atom M, the frequency of the absorption band between 725 and 820 cm^{-1} decreases linearly with the reduced mass of the diatomic group M-carbon. Most monosubstituted benzenes not of the type $(\text{phenyl})_n\text{M}$ also show a high degree of correlation between the frequency of this band and the mass of the atom attached to the ring, but certain substituents produce anomalous shifts of this band. For disubstituted benzenes the effect of the substituents on the frequencies of some of the out-of-plane vibrations can be correlated with the effect of the same substituents on the 725 to 820 cm^{-1} band in monosubstituted benzenes. (auth)

SYNTHESES

5820

Los Alamos Scientific Lab.

PREPARATION OF PURE DIMETHYLBERYLLIUM, INCLUDING A SURVEY OF THE LITERATURE. Sherman W. Rabideau, Mohammed Alei, Jr., and Charles E. Holley, Jr. May 1954. 11p. Contract W-7405-eng-36. (LA-1687)

The preparation and purification of dimethylberyllium together with the physical and chemical properties of this compound are described in detail. Relevant literature references pertaining to dimethylberyllium are included. Analytical results are presented which indicate that essentially pure dimethylberyllium free of diethyl ether can be prepared by making use of the reaction between dimethylmercury and beryllium metal. Some precautions which must be observed in the preparation and handling of this reactive material are given. (auth)

5821

THE C^{14} ISOTOPE EFFECT IN THE CONDENSATION OF BENZOYL BENZOIC ACID-CARBOXYL- C^{14} TO ANTHRAQUINONE-9- C^{14} . W. H. Stevens and D. A. Crowder (Atomic Energy of Canada Ltd., Chalk River, Ontario). *Can. J. Chem.* 32, 792-801(1954) Aug.

Benzoylbenzoic acid-carboxyl- C^{14} was synthesized. The C^{14} isotope effect in the condensation of this acid to anthraquinone-9- C^{14} in concentrated sulphuric acid has been

measured, and the ratio of the reaction rates, $k(14)/k(12)$, found to be 1.074 ± 0.003 . It is suggested that this result supports the mechanism for this reaction proposed by Newman. (auth)

URANIUM AND URANIUM COMPOUNDS

5822

HETEROMETRIC MICRO-DETERMINATION OF URANIUM(VI) BY PRECIPITATION AS PHOSPHATE. M. Bobtelsky and Mordchai Halpern (Hebrew Univ., Jerusalem, Israel). *Anal. Chim. Acta* 11, 188-91(1954) Aug. (In English)

A method is presented for the heterometric determination of uranium(VI) by titration with a solution of Na_2HPO_4 . One to eight mg uranium in 10 ml solution can be determined with an accuracy of 0.01 mg in about 15 minutes. The influence of various nitrogen compounds and different working conditions was studied. (auth)

5823

ABSORPTION SPECTRA OF URANIUM(IV) FLUORIDES.

Dieter M. Gruen and Mark Fred (Argonne National Lab., Lemont, Ill.). *J. Am. Chem. Soc.* 76, 3851-3(1954) July 20.

The absorption spectra of UF_4 , NaUF_3 , KUF_3 , $\delta\text{-Na}_2\text{UF}_6$, and $\gamma\text{-Na}_2\text{UF}_6$ were studied at room temperature and liquid N_2 and He temperatures in the region 4000 to 7000 Å. The absorption maxima are graphed and tabulated. (J.S.R.)

ENGINEERING

5824

Standard Oil Co. of Ind.

DEVELOPMENT AND EVALUATION OF HIGH TEMPERATURE GREASES. QUARTERLY REPORT NO. 12. Edward A. Swakon and Arthur C. Borg. Apr. 1954. 18p. Contract AF 33(038)-23687. (NP-5282)

Present work is directed toward developing silicone greases for the temperature range -65 to 450°F , greases made with fluids other than silicone oil for the same temperature range but with better lubricity, and greases for use at temperatures as high as 700°F . The new formulation, MLG-9305, appears to be comparable to MLG-9301 in performance. Bearing tests at 450°F and 10,000 rpm ran 272 and 776 hr and ran 225 hr at 500°F . MLG-9305 possessed good mechanical stability. Thirteen bearings tests, eight at 450 and five at 500°F were completed on the ABEC-NLGI tester. One grease made with a silicone fluid which meets the rheological requirements at -65°F ran for 782 hr at 450°F ; at 500°F it lasted 101 hr. Gear-wear tests were run on greases made with blends of di-2-ethylhexyl-sebacate and silicone fluids. A surprisingly large proportion of diester was required to show any significant improvement in lubricity. A cursory examination was made of various fluids for heat stability and volatility at 450 and at 550°F , greases made with various types of untreated and organic-coated silicas and clays for mechanical stability after heating, and compounds for preventing gelation of silicone fluid at 550°F . (auth)

5825

Mine Safety Appliances Co.

EMERGENCY SEAL FOR LIQUID SODIUM. V. K. Heckel and E. C. King. Aug. 13, 1954. 10p. Contract NOas-65426, Technical Report No. 30. (NP-5292)

A valveless emergency seal for sodium can be formed by freezing the leaking fluid in small tubing. Tests with a 0.035-in. wall, 0.125-in. OD tube have shown that ambient temperature is the determining factor in sodium travel before freezing. Sodium temperatures and pressures ranged from 400 to 1030°F and 25 to 125 psig. Ambient temperatures ranged from 72 to 180°F, giving a maximum sodium travel of 16.6 ft at the highest temperature. (auth)

5826

Works Control Lab., Babcock and Wilcox Co.
TEST AND ASSEMBLY DATA FOR BOILER TEST VESSELS.
[JOB] AEJ-4. REPORT NO. 250. O. R. Carpenter and C. Floyd. Jan. 23, 1953. 46p. (NP-5294)

An evaluation of the fabrication problems found in connection with the boilers to be constructed for the submarine Nautilus indicated a need for experience under operating conditions. Two $\frac{1}{10}$ -volume models were fabricated of the full-size unit, and the tests performed on these units are described. (K.S.)

HEAT TRANSFER AND FLUID FLOW

5827

ON THE CONDUCTION OF HEAT INTO A GROWING VAPOR BUBBLE. H. Kurt Forster (Univ. of California, Los Angeles). *J. Appl. Phys.* 25, 1067-8(1954) Aug.

MATERIALS TESTING

5838

Metallurgical Project, Nuclear Metals, Inc.
ULTRASONIC TESTING OF THE BOND IN CLAD METAL TUBES. W. L. Lees. Aug. 2, 1954. 16p. (MIT-1116)

Design considerations are presented, and their use illustrated, for some aspects of ultrasonic-transmission testing equipment. Based on satisfactory experience, design and operation are described for crystal transducers, received-amplitude discriminator, and driving-pulse generator. No effort is made to report the complete system in detail, since it is a modification of a conventional design. Rather, emphasis is placed on critical details which have appeared in the experience of this laboratory. (auth)

MINERALOGY, METALLURGY, AND CERAMICS

5829

AUTORADIOGRAPHIC STUDIES OF SURFACE DETAIL WITH CHROMIUM-51. L. E. Preuss (Edsel B. Ford Inst. for Medical Research, Detroit, Mich.). *Nucleonics* 12, No. 8, 30-2(1954) Aug.

A unique approach to studies of surface detail of thin evaporated-metal films combines methods of vacuum evaporation, shadow casting, and autoradiography. Details of metal surface structure are determined by a non-destructive technique to better than 40 microns in preliminary studies. (auth)

CERAMICS AND REFRACTORIES

5830

Battelle Memorial Inst.
SINTERING OF HIGH-PURITY MAGNESIA. A. G. Allison,

E. C. Sesler, Jr., N. L. Haldy, and W. H. Duckworth. Aug. 2, 1954. 14p. Contract W-7405-eng-92. (BMI-931)

The effect of the temperature used to calcine the powder on the sinterability of compacts of high-purity magnesia was investigated. A marked decrease in sinterability occurred with the development of periclase during calcination. Proper heat treatment of the powder resulted in nonporous bodies at sintering temperatures as low as 1650°C. It is suggested that proper calcination might also facilitate preparation of nonporous shapes of other oxides. (auth)

5831

Langley Aeronautical Lab., NACA
MECHANICAL PROPERTIES AT ROOM TEMPERATURE OF FOUR CERMETS OF TITANIUM CARBIDE WITH NICKEL BINDER. Aldie E. Johnson, Jr. Apr. 6, 1954. 23p. (NACA-TN-3197)

Room-temperature stress-strain curves are presented for compression, tension, and shear loadings on four compositions of titanium carbide with nickel binder. Values of ultimate strength, modulus of elasticity, modulus of rigidity, Poisson's ratio in the elastic region, density, and hardness for the four materials are tabulated. (auth)

5832

Massachusetts Inst. of Tech.
THE MEASUREMENTS OF THERMAL CONDUCTIVITY OF REFRACTORY MATERIALS. QUARTERLY PROGRESS REPORT FOR THE PERIOD ENDING JULY 1, 1954. F. H. Norton and W. D. Kingery. July 1, 1954. 8p. Contract AT(30-1)-960. (NYO-6445)

Additional thermal conductivity data for BeO-MgO and SiC are reported, and several new materials have been prepared for measurement. Samples of single crystals have been obtained, and a program described for investigating effects of grain boundaries. Preliminary design work has been completed on an apparatus to measure surface emissivity at temperatures up to 2000°C. (For preceding period see NYO-6442.) (auth)

5833

SOLID-STATE EQUILIBRIUM RELATIONS IN THE SYSTEM MgO-Al₂O₃-SiO₂-ZrO₂. Paul G. Herold and W. J. Smothers (Missouri School of Mines, Rolla, and Univ. of Arkansas, Fayetteville). *J. Am. Ceram. Soc.* 37, 351-3(1954) Aug.

Using techniques developed by Goldschmidt and lately utilized by Foster, solid-state equilibria were studied in the system MgO-Al₂O₃-SiO₂-ZrO₂. The ternary systems MgO-Al₂O₃-SiO₂ and MgO-SiO₂-ZrO₂ are the only faces of this four-phase system that have been studied extensively. Compositions in each of the four faces were heated to temperatures below their fusion point, and, after they had been cooled, they were examined by x rays to identify the phases present. After solid-state equilibria was established or verified in the four faces of the system, quaternary compositions were studied to determine the Alkemade tetrahedra. (auth)

5834

PARTICLE-SIZE-DISTRIBUTION ANALYSIS BY A MODIFICATION OF THE TURBIDIMETRIC PROCEDURE OF MUSGRAVE AND HARNER. Richard S. Lamar (Sierra Talc and Clay Co., South Pasadena, Calif.). *J. Am. Ceram. Soc.* 37, 386-90(1954) Aug.

The turbidimetric method of determining particle-size distribution, developed by Musgrave and Harner, was modified and adapted for use with talcs, clays, and similar non-

metallic minerals and ceramic raw materials. Results obtained by this method were found to be reproducible to within $\pm 2\%$ and check with those obtained by the Andreasen pipette method within the same limits of accuracy. The turbidimetric method is useful for the direct determination of sizes from 60 to 0.25μ , equivalent spherical diameter. The entire procedure for a complete particle-size-distribution analysis usually requires less than 1 hr as compared with several days for the analysis of similar materials by the pipette method. (auth)

CORROSION

5835

Oak Ridge National Lab.

A TECHNIQUE FOR CORROSION TESTING IN LIQUID

LEAD. J. V. Cathcart and W. D. Manly. Aug. 19, 1954.

7p. Contract W-7405-eng-26. (ORNL-1737)

A new testing technique was devised which was found to be satisfactory for comparing the dynamic corrosion characteristics of a series of metals in liquid lead. The tests were conducted in small quartz thermal-convection loops. The necessary apparatus was simple, easy to construct, and relatively inexpensive. In addition, the method afforded a means of studying metals such as chromium and molybdenum which, because of difficulties in fabrication or lack of oxidation resistance, could not be tested by more conventional techniques. (auth)

5836

Royal Aircraft Establishment, Farnborough, Hants (England)

CORROSION OF STAINLESS STEEL AND ALUMINUM

ALLOYS IN CONTACT WITH TITANIUM. C. Braithwaite.

Feb. 1954. 19p. (RAE-TN-MET-192)

Titanium samples consisting of 1 in. diameter discs, sheet, and $\frac{1}{2}$ in. diameter threaded bar were placed in contact with stainless steel D.T.D. 166 and aluminum alloys D.T.D. 603 and D.T.D. 610 and exposed to the intermittent seawater spray test for one year. All the titanium samples showed extremely good corrosion resistance by itself or when coupled to itself or when coupled to stainless steel or aluminum alloy. Slight corrosion of stainless steel occurred inside the joints. There were only slight signs of corrosion of the aluminum alloy sheets before opening the joints. It was found that serious corrosion of the aluminum had occurred at the interface. Joints wet assembled with pigmented jointing compound D.T.D. 369A showed negligible corrosion. It is recommended that wherever possible joints between titanium and other metals should be wet assembled with D.T.D. 369A, and the exterior of the joints should be painted. Aluminum alloys should be anodized. (auth)

5837

STUDIES IN THE URANIUM-BISMUTH FUEL SYSTEM.

J. E. Atherton, D. H. Gurinsky, O. F. Kammerer, C. Klamut, M. Silberberg, B. Turovlin, and J. Weeks (Brookhaven National Lab., Upton, N. Y.). NUCLEAR ENGINEERING, PART II, Chem. Eng. Progr. Symposium Ser. No. 12, 23-7 (1954)

Static and dynamic corrosion tests were made on Cr-Mo and Cr-Si steels in contact with liquid Bi-U. Zr inhibition studies, a liquid metal convection pot, and solubility of Fe in liquid Bi are described. (L.T.W.)

GEOLOGY AND MINERALOGY

5838

BENEFICIATION OF FLORIDA ALUMINUM PHOSPHATE

ORE. J. E. Davenport, Frank Carroll, and Grady Tarbutton (Tennessee Valley Authority, Wilson Dam, Ala.). Ind. Eng. Chem. 46, 1608-11(1954) Aug.

Large deposits of a low-grade, soft aluminiferous phosphate ore overlie beds of pebble phosphate in Florida. The ore varies in composition and physical characteristics. A potential source of uranium as well as phosphorus, it is discarded when the pebble is mined. Three processes were developed for beneficiating the ore. Both of the grinding and sizing processes work in either wet or dry systems with ore having certain physical characteristics. The third process, a more expensive flotation process, has wider application and recovers more of the phosphate as a richer concentrate. The applicability of these processes to the aluminum phosphate deposits as a whole can be generalized only after more is learned about the deposits. (auth)

METALS AND METALLURGY

5839

Massachusetts Inst. of Tech.

HIGH TEMPERATURE STRENGTH OF WROUGHT

ALUMINUM POWDER PRODUCTS. Eric Gregory and

Nicholas J. Grant. [1953] 29p. Contract AF-33(616)-284. (AD-20804)

The creep-rupture properties of wrought powder products from 5 grades of sintered Al powder were investigated from 400 to 900°F for rupture times up to 1000 hr. The effect of stress concentrations on this type of material was determined by means of notched creep-rupture tests. Electron micrographs indicated that the high-temperature creep-rupture properties varied with the oxide content and structure of the materials. (auth)

5840

Research Lab., Allegheny Ludlum Steel Corp.

INVESTIGATION OF HIGH TEMPERATURE PROPERTIES

OF 13 Cr-15 Ni AUSTENITIC STEEL CONTAINING Mo, W, Ti, AND B. R. R. MacFarlane, E. E. Reynolds, and W. W. Dyrkacz. Oct. 13, 1953. 30p. Contract AF-33(616)-258. (AD-23435)

A study was made of the effect of composition variations on the room-temperature tensile properties and the rupture properties of Fe-base alloy containing 11 to 14% Cr, 13 to 17% Ni, and small amounts of Mo, W, Ti, and B. A steel containing 12.5% Cr, 15% Ni, 2% Mo, 0.4% W, 0.5% Ti, 0.1% B, and 0.06% C was found to have outstanding stress-rupture properties in the 1200 to 1500°F range. These properties and good room-temperature tensile properties were obtained by hot-cold working at 1500°F. Limited composition variations indicated that Mo, W, Ti, and B were beneficial and that C and Al were detrimental in their effects on rupture properties. C had no apparent effect. (auth)

5841

Minerals Research Lab., Inst. of Engineering Research, Univ. of Calif., Berkeley

FUNDAMENTALS OF GLASS-TO METAL BONDING. 4.

WETTABILITY OF SOME METALS BY POTASSIUM

SILICATE AND SODIUM BORATE GLASSES. Joseph A.

Pask, Alex Kaminski, and David W. Mitchell. June 21, 1954. 28p. Contract AT-(11-1)-34, Technical Report No. 4. (AECU-2925)

Contact angles versus time of Au, Pt, Fe, Ta, Mo, and W with potassium silicate, sodium borate, and sodium silicate glasses at 900°C and a pressure of approximately 10^{-4} mm Hg are presented. A few glasses were prepared with iron oxide and tungsten oxide in solution, and their

contact angles determined on iron and tungsten. Indications strongly point to existence of reactions of some sort between the glass and metal for most combinations. These are variations in contact angle vs. time curves for a given glass, lack of the same decreasing or increasing order of the contact angles of the metals for different glasses, and identification of a compound at the interface of tantalum and sodium silicate. Such reactions will decrease the interfacial tension between metal and glass. Solution of metal oxides in a glass may have a small effect on its surface tension but may considerably affect the interfacial tension between the glass and metal. (For preceding report in series see AECU-2780.) (auth)

5842

Argonne National Lab.

CONTRIBUTION TO THE MATHEMATICS OF ZONE MELTING. Leslie Burris, Jr., C. H. Stockman, and I. G. Dillon. July 7, 1954. 22p. Contract W-31-109-eng-38. (ANL-5294)

5843

Watertown Arsenal Lab.

WELDING OF TITANIUM ALLOY PLATE. REPORT 1-1W. John J. Burke. Apr. 1952. 19p. (ATI-168445)

During recent research on titanium, $\frac{1}{2}$ in. titanium alloy plates, of Mn-Ti and Cr-Fe-Ti composition, respectively, were welded by commercially reproducible welding methods, and the weldments subjected to ballistic tests. These tests established the fact that these titanium weldments made from two titanium alloys possessed a moderate degree of resistance to ballistic shock attack. (auth)

5844

Naval Engineering Experiment Station, Annapolis
EVALUATION OF WELDED JOINTS BETWEEN AISI 347 STAINLESS STEEL AND 70-30 COPPER NICKEL ALLOY TUBES UNDER THERMAL SHOCK. W. E. Clautice. Sept. 4, 1953. 26p. (EES-060064; AD-20424)

New type, welded, bi-metallic joints uniting components in emergency heat exchangers in newly developed submarine propulsion plants were evaluated under conditions of thermal shock. In their present state of development, they are considered unsatisfactory for the naval service. (auth)

5845

Naval Engineering Experiment Station, Annapolis
THERMAL SHOCK TEST ON PROJECT ELLIS TRANSITION WELD TEST ASSEMBLY NO. 3 FOR 1050°F-2000 PSI SERVICE. J. H. Siegel and R. W. Stevens. May 2, 1953. 16p. (EES-060074B; AD-23389)

The welded transition joints intended for joining the austenitic stainless steel nozzle chamber to the ferritic steel casing of a main steam turbine were investigated. A mock-up test assembly intended for 1050°F-2000 psi steam service was subjected to 600 cycles of thermal shock on the bore of the stainless steel nozzle. After surface examination, the assembly was dissected for metallurgical examination. Sections from the root of the transition weld were found to be free of harmful defects, although the stainless steel nozzle portion of the assembly had bulged in the vicinity of the shocks. (auth)

5846

Research Lab., Wall Colmonoy Corp.
[DEVELOPMENT OF BRAZING ALLOYS]. THIRD QUARTERLY PROGRESS REPORT COVERING THE PERIOD FROM MAY 15, 1954 TO AUGUST 15, 1954. Forbes M.

Miller and Homer S. Gonser. 20p. Contract AF 33(616)-2287. (NP-5288)

A number of brazing alloys on the base metals Inconel and 304 stainless steel were tested for tensile and shear strengths. Oxidation tests were also made. The results of the tests are tabulated. (J.S.R.)

5847

Battelle Memorial Inst.

THE EFFECT OF MICROSTRUCTURE ON THE MECHANICAL PROPERTIES OF TITANIUM ALLOYS. INTERIM REPORT NO. 1. HEAT TREATMENT AND MECHANICAL PROPERTIES OF TITANIUM-COPPER ALLOYS. F. C. Holden, A. A. Watts, H. R. Ogden, and R. I. Jaffee. May 1, 1954. 54p. Contract DA-33-019-ORD-1397. (NP-5291)

The transformations of greatest interest in the titanium-copper alloys in the composition range studied are those which involve the decomposition of the beta phase. Low-temperature aging of the alpha phase by precipitation of Ti_2Cu shows little promise of increasing strength by this process. Solid-solution strengthening of the alpha phase is effective but is limited to alloys containing less than 2.1 per cent copper. Strengths are increased at a rather slow rate by an increase in the quantity of Ti_2Cu in a saturated alpha matrix produced by annealing below the eutectoid temperature. The maximum strengths which have been obtained in the hypoeutectoid alloys have been obtained by quenching from the beta field. Strengths of these martensitic structures increase almost directly with copper content at a rate of about 14,000 psi for each per cent of copper added. Hardness data indicate that slightly higher strengths, particularly in hypereutectoid alloys, can be produced by use of an oil quench in place of the water quench. The similarities in phase relationships which exist for the titanium-copper alloys and the iron-carbon alloys are apparent in their microstructures. Eutectoid decomposition products produced by slow cooling or by isothermal transformation appear very similar to the nodular pearlite structures found in steels. The desirable combinations of properties obtained in tempered-martensite steels have not been produced in titanium-copper alloys. (auth)

5848

Pittsburgh Univ.

APPLICATION OF CHEMICAL THERMODYNAMICS TO THE STUDY OF ALLOY FORMATION. PROGRESS REPORT FOR APRIL 1, 1954 TO JULY 1, 1954. R. S. Craig, T. D. Brotherton, W. V. Johnston, S. Kamath, and C. A. Krier. July 12, 1954. 13p. Contract AT(30-1)-647 (NYO-6322)

The heat capacity of pure potassium from 12 to 320°K is given. Powder x-ray photographs were taken of $MgCd_3$ at several temperatures below the ice point. The construction and operation of a low-temperature thermostat is described in detail. (For preceding period see NYO-6320.) (auth)

5849

Culcheth Labs., Research and Development Branch, Dept. of Atomic Energy (England)
THE SOLUBILITY OF OXYGEN IN SODIUM AND SODIUM-POTASSIUM ALLOY. J. D. Noden and K. Q. Bagley. July 20, 1954. 18p. (RDB(C)-TN-80)

The solubility of oxygen in sodium has been determined in the temperature range 130 to 540°C and of oxygen in sodium-potassium alloy in the range 20 to 176°C, using apparatus in both glass and stainless steel. The results suggest that the solution formed approximates to an ideal

solution but that the partial heat of solution changes abruptly at 260 to 270°C. Sources of error encountered during the use of the glass apparatus have been investigated. (auth)

5850

Sylvania Electric Products, Inc., Atomic Energy Div.
ROLLING 18-8 STAINLESS STEEL POWDER INTO STRIP.
S. Storchheim, J. Nylin, and B. Sprissler. July 5, 1954.
55p. (SEP-161)

The rolling of stainless steel powder into strip form was studied as a function of a number of green rolling, sintering, and rerolling variables. Stainless steel strips were produced of high density, good strength, good elongation, practically no preferred orientation, and good corrosion resistance. (auth)

5851

Rock Island Arsenal Lab.
INERT ARC WELDING OF COMMERCIAL PURE TITANIUM SHEET. REPORT NO. 1. Warren E. Peterson. Aug. 11, 1952. 45p. (U-24025; ATI-164250)

5852

Carnegie Inst. of Tech.
TORSION PRE-STRAIN AND THE FATIGUE LIFE OF RC-55 TITANIUM ALLOY. INTERIM REPORT. J. G. Kaufman and E. D'Appolonia. 1954. 62p. Contract DA-36-061-ORD-362. (WAL-401/68-42)

The effect of torsional prestrain on the behavior of RC-55 titanium alloy was studied with rotating beam fatigue tests. Torsional prestrain ranged from 5 to 60% of the torsional strain to failure. Rotating beam specimens were then machined from the twisted alloy and fatigue tested at 10,000 rpm and room temperature (70°F). Data from tests of torsionally prestrained specimens were compared with data from tests of otherwise similar specimens that were not prestrained. The effect of stress concentrations on RC-55 titanium alloy prestrained in torsion was also studied. Notched fatigue specimens were made of virgin bars and of bars that were prestrained in torsion. These specimens were tested in a rotating-beam machine at 10,000 rpm and room temperature. Internal heating was studied by comparing data from tests of unnotched specimens at room temperature with data from tests conducted while water circulated over the specimen. Tests with coolant were made on one high and one low range of prestrain. The tests were duplicated on two groups of specimens which were prestrained to approximately 20 and 40% of the tensile strain to fracture. Notched and unnotched specimens, with and without liquid coolant, were tested for each prestrain. (auth)

5853

NUCLEAR POWER. URANIUM FABRICATION. *Nucleonics* 12, No. 8, 53(1954) Aug.

A process for U fabrication developed in Belgium is described which is said to permit more economical preparation of high-purity fuel elements. (C.H.)

5854

INVESTIGATION OF THE PLASTIC PROPERTIES OF COMMERCIAL TITANIUM. L. N. Sokolov, V. P. Elyutin, and V. I. Zalesskii. *Izvest. Akad. Nauk S.S.S.R. Otdel. Tekh. Nauk*, No. 3, 110-15(1954) Mar. (In Russian).

The dependence of plasticity, resilience, and tensile strength of commercial Ti on temperature was experimentally determined. It was shown that at temperatures above 700° Ti

has very high plasticity, not dependent on the rate of deformation within the limits used in this test. At temperatures below 700° at lesser rates of deformation Ti has marked plasticity. The percentage of C in Ti in the range from 0.46 to 0.88% at temperatures higher than 700° does not appear to affect the plasticity. Recrystallization of commercial Ti appears at 700° in the process of plastic deformation. (tr-auth)

5855

NOTE ON THE CONSTITUTION OF THE TITANIUM-GOLD SYSTEM IN THE REGION 0-6 ATOMIC PER CENT GOLD. M. K. McQuillan (Imperial Chemical Industries, Ltd., Birmingham, England). *J. Inst. Metals* 82, 511-12(1954) July.

Micrographic examination of quenched specimens has shown that the titanium-gold system is of the eutectoid type. The eutectoid temperature has been found to be $830 \pm 2^\circ\text{C}$ and the solubility of gold in the α solid solution at this temperature is approximately 3 at. %. The second constituent is Ti_3Au . (auth)

5856

EXPLORATORY CREEP TESTS ON METALS OF HIGH MELTING POINT. N. P. Allen and W. E. Carrington (National Physical Lab., Teddington, Middlesex, England). *J. Inst. Metals* 82, 525-33(1954) July.

The strength at 1000°C of a number of metals, in their purest available form, with melting points above that of iron, was assessed by compression creep tests in vacuo, the criterion being the stress needed to give 1% creep strain in 24 hr. Titanium, zirconium, vanadium, niobium, tantalum, chromium, molybdenum, tungsten, platinum, palladium, rhodium, iridium, iron, cobalt, and nickel and certain sintered carbides were tested. When high-temperature strength was plotted against atomic number, a periodicity similar to that given by the melting points and elastic constants of the metals was obtained. The materials tested are discussed in the light of their usefulness for high-temperature service. (auth)

5857

THE CONSTITUTION OF THE TITANIUM-RICH ALLOYS OF TITANIUM, IRON, AND OXYGEN. N. P. Allen, T. H. Schofield, and B. Mellish (National Physical Lab., Teddington, Middlesex, England). *J. Inst. Metals* 82, 534-8(1954) July.

The constitution of the titanium-rich alloys of titanium, iron, and oxygen has been investigated between 550 and 1100° C by microscopical and x-ray methods. Alloys containing up to 5% oxygen and 5% iron have been prepared by arc melting. The α and β phase fields are restricted at all temperatures, and the extent of the $(\alpha + \beta)$ field decreases with falling temperature between 1100 and 650° C owing to the progression of the $(\alpha + \beta + x)$ and the $(\alpha + x)$ fields, where x is a complex oxide of titanium and iron. At 550° C all the alloys investigated, except for a restricted α field, consist of $(\alpha + \text{FeTi})$. (auth)

5858

DESCALING AND BRIGHTENING OF TITANIUM AND ITS ALLOYS WITH PYROPHOSPHORIC ACID. H. W. Worner (Univ. of Melbourne, Australia). *Bull. Inst. Metals* 2, 131-2(1954) July.

Pyrophosphoric acid at $270 \pm 10^\circ\text{C}$ was found to remove the common dark grey oxide layers of hot-worked or heat-treated Ti and Ti-rich alloys in $\frac{1}{4}$ to 1 min, the actual time required depending on the thickness of the oxide. The metal or alloy is left with a bright surface which is much smoother

than that obtained by the use of the mixture of concentrated HNO_3 (80 % by vol.) and concentrated HCl (20 % by vol.) (auth)

5859

ON THE POLYGONIZATION OF ALUMINUM OF DIFFERENT PURITIES. Christian de Beaulieu, Jean Talbot, and Georges Chaudron. *Compt. rend.* 239, 270-2(1954) July 19. (In French).

5860

SELENIUM. J. D. Sargent (Bureau of Mines, Washington, D. C.). *U. S. Bur. Mines Inform. Circ.* 7690, July 1954, 25p.

A summary is given of the physical and chemical properties of Se and its geology, mineralogy, geographic distribution, foreign production, domestic production and consumption, metallurgy, and uses. 187 references. (J.S.R.)

5861

HYDROGEN-PROTECTED NICHROME BRAZING. Paul C. Ziemke (Carbide and Carbon Chemicals Co., Oak Ridge, Tenn.). *Ind. Eng. Chem.* 46, 107A-9A(1954) Aug.

Methods, equipment, and precautions in using H_2 atmosphere for Nichrome brazing are described. Methods of eliminating explosive hazards by pressure bank control in case of gas cutoff and then startup, He purge of the H_2 supply due to pressure failure, and vent orifices for gas burnoff or discussed. Automatic lighting of the gas and maintaining the flame as long as a flammable mixture is flowing by an electrically heated filament kept at incandescent temperatures are discussed. (J.A.G.)

5862

HIGH TEMPERATURE OXIDATION CHARACTERISTICS OF SOME MANGANESE-ALUMINIUM STEELS. PART I. A. A. Krishnan and Ved Prakash (National Metallurgical Lab., Jamshedpur, India). *J. Sci. Ind. Research (India)* 13B, 444-9(1954) June.

Oxidation characteristics of some manganese-aluminum steels between 600° and 1,100°C for short durations are reported. The manganese content of the steels varied from 0.4 to 26.2 per cent and that of aluminum from 8 to 11 per cent. The oxidation characteristics of most of the manganese-aluminum steels obey parabolic law at 600° to 700°C. The addition of manganese in 8 to 11 per cent aluminum steels results in increased oxidation at all temperatures from 600° to 1,000°C. However, steel containing 6.5 per cent manganese and 8 per cent aluminum resists oxidation slightly better than 11 per cent aluminum steel at 1,100°C. (auth)

5863

A METHOD FOR THE MEASUREMENT OF CONDUCTIVITY OF METALS AT MICROWAVE FREQUENCIES. S. K. Chatterjee, P. Ramdas Shenoy, and C. Rama Bai. *J. Indian Inst. Sci.* 36, Sect. B, 107-22(1954) July.

A theory for a new method of determining the conductivities of metals at microwave frequencies from the measurements of reflection coefficients has been worked out with the help of field equations. An expression for the reflection coefficient in terms of voltage standing wave ratio, attenuation constant, scattering coefficient of any waveguide discontinuity present in the system, and phase factors has been derived. The values of conductivity for several metals obtained by this method agree well with the values obtained by other existing methods. (auth)

5864

THERMAL DIFFUSIVITY OF METALS AT HIGH TEMPERA-

TURES. D. Rosenthal and N. E. Friedmann (Univ. of California, Los Angeles). *J. Appl. Phys.* 25, 1059-60(1954) Aug.

A method of measuring the thermal diffusivity of metals at high temperatures is presented which possesses additional advantages over the procedure due to Angstrom. A moving heat source, covering a wide range of temperatures in a single run, sweeps a long bar of the sample material to be tested. A plot is made of the log of the temperature variation with time at a point removed from both ends of the bar. The slopes of this curve, β and β' , corresponding to the same temperature on the rising and falling portions of the plot are shown to be related to the thermal diffusivity α by the relation $\alpha = v^2/(\beta + \beta')$, where v is the velocity of the heat source. The method is used to determine α for several alloys, and the results are equal or superior to values afforded by other direct methods. (K.S.)

5865

EFFECT OF SIGMA PHASE ON PROPERTIES OF ALLOYS. Adolph J. Lena (Allegheny Ludlum Steel Corp., Brackenridge, Penna.). *Metal Progr.* 66, No. 2, 94-9(1954) Aug.

The magnitude of the effect which sigma phase may have on mechanical and corrosion properties of stainless steels depends not only on the amount present but also on particle size and distribution. General conclusions are given regarding effect on notch-sensitivity, ductility at room and elevated temperature, tensile strength, and results of corrosion tests. (auth)

PHYSICS

5866

Hydrodynamics Lab., Calif. Inst. of Tech.

THE GROWTH OF VAPOR BUBBLES IN SUPERHEATED LIQUIDS. REPORT NO. 26-6. M. S. Plesset and S. A. Zwick. Aug. 1953. 24p. Contract N6onr-24426. (AD-19784)

The growth of a vapor bubble in a superheated liquid is controlled by the inertia of the liquid, the surface tension, and the vapor pressure. As the bubble grows, evaporation takes place at the bubble boundary, and the temperature and vapor pressure in the bubble are decreased. The heat inflow requirement of evaporation, however, depends on the rate of bubble growth, so that the dynamic problem is linked with a heat diffusion problem. Since the heat diffusion problem has been solved, a quantitative formulation of the dynamic problem can be given. A solution for the radius of the vapor bubble as a function of time is obtained. This asymptotic solution covers the range of physical interest since the radius at which it becomes valid is near the lower limit of experimental observation. It shows the strong effect of heat diffusion on the rate of bubble growth. Comparison of the predicted radius-time behavior with experimental observations in superheated water shows good agreement. (auth)

5867

Argonne National Lab.

THE IONIZATION IN FREE AIR AROUND POINT SOURCES OF BETA RADIATION. R. K. Clark, S. S. Brar, and L. D. Marinelli. Aug. 1954. 61p. Contract W-31-109-eng-38. (ANL-5201)

The ionization produced in air by P^{32} , Y^{91} , Ti^{204} , and Bi^{210}

point sources has been studied as a function of distance (22.4 to 681.1 mg/cm²) from the source. The measurements were made in a room of sufficient size to minimize the effects of scattering by the surroundings. Absorption and scattering in the mounting and supports of the source were minimized by drying it on thin films (100 to 200 µg/cm²) and suspending the assembly from fine wires. The ionization was measured with a thin-walled aluminum chamber and with a parallel plate chamber composed of grids, the optical transmission of which was about 99 per cent. The bulk of the experimental work consisted in demonstrating that undesired residual absorption and/or scattering had indeed been eliminated or properly accounted for. The absolute effective collecting volume of the grid ionization chamber was determined by three different methods. The ionization distribution was computed theoretically by neglecting multiple scattering and by assuming that the stopping power was either independent of the kinetic energy or inversely proportional to the kinetic energy. Accepted energy spectra of the sources were used. The results indicate that these approximations are not adequate for accurate work. These experimental results were compared also with the published results of other workers and found in reasonable agreement with the empirical form suggested by Loevinger. (auth)

5568

Ames Lab.

VARIATIONS OF ELECTROPHOTOLUMINESCENCE PHENOMENA WITH FREQUENCY OF APPLIED FIELD. Keith William Olson and G. C. Danielson. June 1954. 101p. (ISC-492)

An a-c field applied to a long-persistence phosphor may cause an initial momentary increase in the emission intensity (fleeting illumination) followed by a decrease in the intensity (extinction). At the removal of such a field, a sudden increase (inversion) may be observed. For the P-14 phosphor, the light sum (intensity-time product) of fleeting illumination was independent of field frequency in the range $80 \leq \nu_f \leq 5000$ cps, for the field strengths $1.3(\pm 0.2) \times 10^4 \leq E \leq 4.0(\pm 0.2) \times 10^4$ v/cm, and at the temperatures $26(\pm 1) \leq T \leq 60(\pm 5)^\circ\text{C}$. For the P-7 phosphor, the fleeting illumination was quite probably independent of field frequency for the field strengths $2.0(\pm 0.2) \times 10^4 \leq E \leq 6.5(\pm 0.2) \times 10^4$ v/cm, and at the temperatures $12(\pm 2) \leq T \leq 74(\pm 6)^\circ\text{C}$. These results are explained by the proposed mechanism that field accelerated electrons in the conduction band would collide with filled, deep, impurity-induced traps, and would empty these traps essentially instantaneously. For the P-14 phosphor, the extinction also was frequency independent. For the P-7 phosphor, the extinction varied as the natural logarithm of twice the field frequency at temperatures less than 33°C , and tended to become frequency independent at higher temperatures. Qualitative explanations are suggested for these variations. The inversion effect increased with increasing values of all parameters. Under certain conditions, the emission intensity failed to return to its normal value for appreciable times after field removal. (auth)

5889

Knolls Atomic Power Lab.

DIFFUSION STUDIES. 2. THE PERMEABILITY OF PALLADIUM TO HYDROGEN AND TO TRITIUM. O. N. Salmon and D. Randall. May 14, 1954. 54p. Contract W-31-109-Eng-52. (KAPL-984)

The permeability of clean and active palladium to hydrogen and to tritium as a function of temperature and pressure was measured from 200 to 600°C and from 10^{-3} to 20 cm mercury. For a palladium membrane of uniform thickness and with a radius of curvature that is large relative to the thickness, the steady-state rate of diffusion R in cc of gas (STP) per minute for negligible downstream pressure is given by, for pure hydrogen

$$R = \frac{78 AP_1 \exp(-2620/T)}{1 + 2.52 d_0 \sqrt{P_1} \exp(-831/T)}$$

for pure tritium

$$R = \frac{32.3 AP_1 \exp(-2850/T)}{1 + 1.34 d_0 \sqrt{P_1} \exp(-733/T)}$$

where P_1 is the upstream hydrogen or tritium pressure in cm Hg, T is the absolute temperature in $^\circ\text{K}$, d_0 is the palladium membrane thickness in mils, and A is the cross sectional area of the membrane normal to the diffusion direction in cm². The two important rate-determining processes in the permeation are the sorption of hydrogen and tritium at the palladium surface and the diffusion of protons and tritons in the palladium lattice. For the surface process the activation energy for the hydrogen is less than that for tritium. For the diffusion in the lattice the activation energy for a proton is greater than that for a triton. The permeation rate for hydrogen is greater than that for tritium, but the ratio of the two shifts toward unity as the temperature increases. (auth)

5870

Massachusetts Inst. of Tech.

STUDY OF METAL-CERAMIC INTERACTIONS AT ELEVATED TEMPERATURES. QUARTERLY PROGRESS REPORT FOR THE PERIOD ENDING JULY 1, 1954. F. H. Norton and W. D. Kingery. July 1, 1954. 15p. Contract AT(30-1)-1192. (NYO-6295)

Surface tension measurements have been completed for the systems iron-oxygen, iron-carbon, iron-sulfur, and iron-nitrogen. Results and analysis of results are presented in part. Alloys of nickel with various metallic additions have been prepared and checked for homogeneity. (For preceding period see NYO-6294.) (auth)

5871

Radiation Lab., Univ. of Calif., Berkeley

HIGH ENERGY PARTICLE DATA. Beverly Hill Willis. Oct. 1953. 62p. Contract W-7405-eng-48. (UCRL-2426)

An extensive collection of graphs has been constructed for rapid calculations and conversions (laboratory systems to c.m. systems) associated with the measurement of high-energy reactions involving electrons, mesons (μ and π), protons, deuterons, and α particles. Relationships between β , H_p , and p are given as a function of energy for all particles. Range-energy relationships are also given for appropriate energies. A set of master curves is included so that similar graphs may be readily constructed for other particles. (K.S.)

5872

IONIZATION PROBABILITY CURVES NEAR THRESHOLD FOR Zn, Cd, AND Hg. W. M. Hickam (Westinghouse Research Labs., East Pittsburgh, Penna.). *Phys. Rev.* **95**, 703-5 (1954) Aug. 1.

The ionization probability curves near threshold of the closely related elements zinc, cadmium, and mercury have been obtained using nearly monoenergetic electrons. Structure observed in the curves is interpreted as the result of autoionization of states of the atom which arise from the excitation of a single inner shell electron. In the analysis of the results, it is necessary to consider both the optically allowed and forbidden excited states. The energy levels of the optically allowed states of this system have been identified by Beutler, but the locations of the optically forbidden states are unknown. (auth)

5873

PREPARATION AND HALF-LIFE OF Cr^{55} . G. A. Bazorgan, J. W. Irvine, Jr., and C. D. Coryell (Massachusetts Inst. of Tech., Cambridge). *Phys. Rev.* **95**, 781(1954) Aug. 1

Cr^{55} has been prepared by $\text{Mn}^{55}(\text{d}, \text{p})$ and $\text{Cr}^{54}(\text{n}, \gamma)$ reactions. A half life of 3.62 ± 0.15 minutes is observed, and the thermal neutron cross section for the production of this nuclide is 0.36 ± 0.04 barn. (auth)

5874

ULTRAVIOLET PHOTONS IN THE DECAY OF META-STABLE ARGON ATOMS. L. Colli (Laboratori CISE, Milan, Italy). *Phys. Rev.* **95**, 892-4(1954) Aug. 15.

Some measurements of the lifetime of uv photons emitted by the excited states of argon are reported, when the excitation is obtained by the impact of the electrons in a Townsend avalanche. The measurements were made by converting the ultraviolet into visible light by means of a fluorescent screen and by observing the visible light with a photomultiplier. The results are that the energy of the uv photons is about 10 ev and that the law of emission in time is represented by the formula $\exp(-t/\tau_A) - \exp(-t/\tau_M)$, where $\tau_A = 3.4 \times 10^{-6}$ sec and $\tau_M = 1/p^2$ sec (p = gas pressure in mm Hg). (auth)

5875

LAMBDA TRANSITION OF LIQUID HELIUM. D. ter Haar (St. Salvator's Coll., St. Andrews, Scotland). *Phys. Rev.* **95**, 895-7(1954) Aug. 15.

An approximate partition function for a system of interacting Bose-Einstein particles is derived, which is nearly the same as the one derived by Feynman, by neglecting the noncommutability of the potential and kinetic energy operators. Reasons are given for believing that the approximations introduced in deriving the partition function rather than those introduced in the further development of the partition function are responsible for the difference between the observed and the predicted order of the transition. (auth)

5876

RELATIVISTIC AND MAGNETIC SPIN INTERACTIONS IN HELIUM-LIKE ATOMS. J. Sucher and H. M. Foley (Columbia Univ., New York). *Phys. Rev.* **95**, 966-9(1954) Aug. 15.

Relativistic and magnetic spin corrections to the ionization energy of He and O^{6+} are given. The magnetic spin interaction given by Sessler and Foley has been derived by a careful evaluation of the Breit operator. The relativistic corrections obtained by reduction of the Dirac equation differ from some previous expressions. With all known corrections taken into account, there remains a discrepancy with experiment of about 30 cm^{-1} in the case of He. Within the rather large experimental and theoretical uncertainties, there appears to be no residual discrepancy in the case of O^{6+} . (auth)

5877

CONTRIBUTION TO THE STUDY OF SOURCES OF THORIUM C AND THORIUM C'. Marie Ader (Coll. de France, Paris). *J. phys. radium* **15**, 583(1954) July-Aug.-Sept. (In French).

An active deposit of Th on a Ag disk is a source of ThA , ThB , ThC , ThC' , and ThC'' . Some rays with a long path in air were emitted from such a source. An attempt was made to identify the radiation by placing a thin gold screen between the source and a nuclear emulsion. The particles with long path were emitted oriented in a fan-shaped form. The suggestion that the paths are caused by recoil protons is rejected. The most plausible explanation appears to be that, analogous to Po sources, there is a spontaneous emission of nuclei of ThC or ThC' or other nuclei of the Th family. (J.S.R.)

5878

HAS LIQUID He^3 ALSO A LAMBDA TRANSITION? J. de Boer. *Ned. Tijdschr. Natuurk.* **20**, 178-82(1954) July. (In Dutch).

5879

NEW RESEARCH TECHNIQUES IN PHYSICS. Symposium organized by the Academia Brasileira de Ciencias and Centro de Cooperacion Cientifica para America Latina (UNESCO), Rio de Janeiro and Sao Paulo, July 15-29, 1952. 449p. Rio de Janeiro, 1954.

AEROSOLS

5880

Indiana Univ.

THE COAGULATION OF AEROSOLS. SCIENTIFIC REPORT NO. 2 [FOR] NOVEMBER 1, 1950-JUNE 30, 1953. Frank T. Gucker, Jr., James J. Egan, Donald G. Rose, and Jesse E. White. July 31, 1953. 72p. Contract AF19-(122)-375. (AD-25729)

5881

GAS ABSORPTION AND AEROSOL COLLECTION IN A VENTURI ATOMIZER. H. F. Johnstone, R. B. Field, and M. C. Tassler (Univ. of Illinois, Urbana). *Ind. Eng. Chem.* **46**, 1601-8(1954) Aug.

A study of the rates and mechanism of transfer in the spray zone of a Venturi atomizer was made to find a basis for the design of this new device for contacting large volumes of gases for absorption and dust collection. Individual film coefficients are very high near the point of liquid injection. The gas film coefficient varies from 500 to 1400 lb-moles/hr/ft³/atm. at 3.5 in. from the liquid source and decreases slowly with distance as the interfacial velocity decreases. The corresponding liquid film coefficient falls off abruptly from a maximum of 5000 to 17,000 lb-moles/hr/ft³/lb-mole/ft³ at about 1 in. downstream to almost zero and 4 in. downstream. The rates of collection of soluble ammonium salt fumes varying from 0.27 to 1.58 μ in mean diameter and of a hydrophobic oil mist of intermediate particle diameter may be correlated on the basis of the inertial impaction mechanism. The results suggest that the atomizer should be useful for rapid degasification of liquids and for absorption of slightly soluble gases which react with the absorbent itself, or with a dissolved component. Equations are proposed by which large-scale scrubbers may be designed for the collection of aerosol particles of any size. (auth)

COSMIC RADIATION

5882

A CLOUD CHAMBER STUDY OF COSMIC RAY SHOWERS UNDER LEAD IN THE NEIGHBORHOOD OF THE SECOND MAXIMUM OF THE TRANSITION CURVE. Georg Pfozter. Translated from *Z. Naturforsch.* 8a, 353-60(1953). 12p. (AERE-Trans-11/3/415)

An abstract of this paper appears in *Nuclear Science Abstracts* as NSA 7-5094.

5883

PRIMARY HEAVY NUCLEI. Thomas H. Stix (Princeton Univ., N. J.). *Phys. Rev.* 95, 782-92(1954) Aug. 1.

Primary cosmic-ray nuclei of $z \geq 2$ were observed in a balloon-borne cloud chamber. The chamber was triggered by events with ionization loss ≥ 6 minimum in each of three proportional counters, arranged in a telescope. Proportional counter pulse amplitudes were recorded by a neon bulb system. Two Skyhook daytime balloon flights at geomagnetic latitude 41° maintained average altitudes of 17.6 and 14.3 g/cm². In the 0.77 hour sensitive time, in two flights, there were observed in the cloud chamber (charge determined from both cloud chamber and proportional counter data) 3 to 5 Li, 1 Be, 0 B, and 21 $z \geq 6$ nuclei. A primary flux of $10.2_{-3.4}^{+4.5}$ particles per m² sec sterad is found for the $z \geq 6$ nuclei. An unusually large fraction of this group is indicated to be heavier than oxygen. The primary flux of Li, Be, and B nuclei is found to be 5_{-5}^{+32} percent of the primary flux of $z \geq 6$ nuclei, from which it is concluded that heavy nuclei have traversed less than 7 g/cm² interstellar hydrogen [= $(4/n) \times 10^6$ light years, where $n = (4/n) \times 10^6$ light years, where n = number of H atoms per cm³]. The proportional counter data alone showed a 14 ± 16 percent decrease in intensity of particles of $z > 8$ from morning to afternoon. (auth)

5884

COSMIC-RAY NEUTRONS IN WATER AT AN ALTITUDE OF 10,600 FEET. Martin Jay Swetnick (New York Univ., New York). *Phys. Rev.* 95, 793-6(1954) Aug. 1.

The neutron component of the cosmic radiation in the first 50-cm layer of water adjacent to the surface of a mountain lake, located at an altitude of 10,600 feet, was studied with the aid of a tray of ten enriched boron trifluoride filled counters connected in parallel. A measure of the thermal neutron intensity was obtained by alternately shielding the tray of counters with tin and cadmium of equal g/cm. A transition region was found to exist between the surface and the 30-cm level wherein the thermal neutron intensity decreased rapidly with depth. Below the 30-cm level, the thermal neutron intensity was found to be almost constant over an interval of 20 cm. The neutron production rate and thermal neutron flux, just below the transition region, were found to be 4.6×10^{-4} neutrons/g/sec and about 4.3×10^{-4} thermal neutrons/cm/sec, respectively. (auth)

5885

NARROW SHOWER OF PURE PHOTONS AT 100 000 FEET. Marcel Schein, D. M. Haskin, and R. G. Glasser (Univ. of Chicago). *Phys. Rev.* 95, 855-7(1954) Aug. 1.

A very unusual event consisting of a large number of individual electron pairs produced in a stack of Ilford G-5 pellicles exposed at 41° N geomagnetic latitude is discussed. No incident charged particle was observed within a radius of 250 μ of the axis of the event. The number of materialized pairs at a given distance was found to increase linearly, and

an estimate of the number of incident photons, derived from this analysis, gives a value of 21 ± 3 . The observed shower was entirely enclosed by a cone of half-angle $\theta \leq 0.001$ radian, proving that the shower was of extremely high energy. The unusual features of this event are discussed in the light of current knowledge, and the nature of a possible process is explored. (K.S.)

5886

PRODUCTION OF COSMIC RADIATION AT THE SUN. J. W. Firor, J. A. Simpson (Univ. of Chicago), and S. B. Treiman (Princeton Univ., N. J.). *Phys. Rev.* 95, 1015-19(1954) Aug. 15.

A calculation is made of the average production rate of 4-Bv cosmic-ray particles at the sun. The calculation is based upon the recent experimental evidence that the frequently occurring small solar flares produce temporary increases of neutron intensity in suitably located neutron pile detectors. This production rate, averaged over the 11-year solar cycle, is somewhat in excess of the absorption rate of 4-Bv particles by bodies in the solar system. If the production at the sun is to account for most of the observed cosmic radiation intensity, a trapping magnetic field is required. Limits on the size of such a trapping volume are estimated by considering the limits of cosmic-ray lifetime; the requirement of a high degree of radiation isotropy at the earth is satisfied. The existence of high-energy particles in the cosmic radiation imposes the principal difficulty for any solar origin hypothesis. (auth)

5887

INVESTIGATION OF THE PRODUCTS OF NUCLEAR FISSION, CAUSED BY THE NEUTRAL COMPONENTS OF COSMIC RADIATION. A. V. Khrimyan. *Doklady Akad. Nauk S.S.S.R.* 96, 1155-8(1954) June 21. (In Russian).

A magnetic spectrometer at 3250m above sea level and field of 6850 gauss was used to investigate the products of stars and to determine their nature. The feasibility of determining the sign of the charge allows the analysis of the star products up to very high energies where the photo method is not applicable (π -p particles). Among the products ($P > 6 \times 10^8$ ev/s) of the single ray stars, generating neutral components, π mesons comprise no more than 5%. Of the heavy particles protons comprise no more than 10 to 20% of all observed generated particles with impulse greater than 9×10^8 ev/s. π Mesons comprise 40 to 50% of the π -p particles. (tr-auth)

5888

COSMIC RAY PHENOMENA AT MINIMUM IONIZATION IN A NEW NUCLEAR EMULSION HAVING A FINE GRAIN, MADE IN THE LABORATORY. Pierre Demers (Univ. of Montreal, Quebec, Canada). *Can. J. Phys.* 32, 538-54(1954) Aug.

The preparation of a silver bromide emulsion in the form of baseless sheets and their use in thick homogeneous stacks are described. In these sheets, a suitable development brings out minimum ionization tracks with a grain diameter 0.1 to 0.2 μ , and a linear grain density of 15 per 100 μ . The sequence of observations which lead to the positive identification of minimum tracks is discussed. Short recoils and delta rays are visible, and excellent discrimination is available at all ionizing powers. The influence of grain size on fog is analyzed. Several cosmic ray phenomena containing minimum tracks are presented: single tracks, hard showers, $\pi\mu e$ events, and an electron pair. Distortion is very small, and it is shown that the

small grain size renders feasible better scattering measurements on higher energy particles. With this emulsion, nearly every possible measurement should become feasible with greater accuracy. (auth)

CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE

5890

PERIODIC IMPURITIES IN A PERIODIC LATTICE. Edward H. Kerner (Univ. of Buffalo, N. Y.). *Phys. Rev.* **95**, 687-9 (1954) Aug. 1.

Because binary delta-function lattices of the Kronig-Penney type which have been previously studied are incapable of describing several important features of real crystals, the eigenvalue problem for a periodic linear chain ...A(BB...BB)A(BB...BB)... of arbitrary square-well, A and B atoms of an arbitrary concentration is taken up and solved. The methods used are generalizable to other binary or multi-ary chains. It is shown that a theorem of Saxon and Hutner and of Luttinger relating to the preservation of the common forbidden energies of pure A and pure B lattices in a mixed A, B, lattice is peculiar to their delta-function representations of A and B, and is without general validity. (auth)

ELECTRONS

5890

ELECTRON-ELECTRON SCATTERING IN ALKALI METALS. Elihu Abrahams (Univ. of Illinois, Urbana). *Phys. Rev.* **95**, 839-40(1954) Aug. 1.

It is shown that the electron-electron mean free path in alkali metals is longer than the electron-phonon mean free path, in the range of temperatures 4 to 300°K. This result is not in agreement with requirement for comparable mean free paths in order to interpret the effect of electron-electron collisions on electron spin resonance line widths, electromagnetic absorptivity, anomalous skin effect in metals, and thermal conductivity. (K.S.)

GASES

5891

Los Alamos Scientific Lab.

THE STRUCTURE OF A SHOCK FRONT IN ARGON.

John W. Bond, Jr. July 1, 1954. 175p. Contract W-7405-eng-36. (LA-1693)

If a one-dimensional shock wave travels through argon, the translational degrees of freedom of the atoms are immediately excited and reach translational equilibrium within two collision lengths. If the shock velocity is sufficiently high, energy will be transferred from the translational degrees of freedom to those of electronic excitation and ionization until complete thermal equilibrium exists. The region between the first disturbance in front of the shock and the point at which thermal equilibrium is first realized is the shock front. A method of computing the equilibrium conditions was used for the argon equilibrium reaction, $A = A^+ + e$, where only singly ionized argon atoms were considered. The corresponding partition functions for density ratios from 2 to 20 and temperatures from 7500 to 26,000° are tabulated. Applying the standard shock relations, the equilibrium conditions behind the shock front were computed for shock velocities between $3 \cdot 10^5$ and $9 \cdot 10^5$ cm/sec for two fore-pressures, viz., $p_1 = 1.0$ and 59.38 cm Hg. The nonequilibrium region which exists between the front of the shock and the equilibrium

region was treated by considering the individual atomic interactions that take place. From the point where translational equilibrium is first reached to a point where there is a sufficient number of electrons for ionizing collisions between electrons and atoms to be of importance, ionizing reactions between argon atoms predominate. Then the reaction $e + A = 2e + A^+$ takes over only to be dampened by recombination between electrons and ions until the gas has been completely equilibrated. Pressure, density, temperature, and degree of ionization were computed across the shock front for various shock velocities and presented in graphical form. Thus the width of the shock front and the relaxation time for ionization are given as functions of shock velocity. Various theories for the recombination of electrons and ions were discussed, and it is shown that Kramers' classical theory of radiative recombination is incorrect but that a quantum theory gives the right order of magnitude result. Three-body recombination coefficients were computed by a method of microscopic reversibility. (auth)

5892

DANCKWERTS THEORETICAL WORK IN THE FIELD OF ABSORPTION. M. Kh. Kishinevskii. Translated from *Zhur. Priklad. Khim.* **27**, 382-90(1954). 8p. (AERE-Trans-11/3/5/453)

Experiments on the mechanism of gas absorption at the liquid-gas interface of an agitated liquid are shown to support a theory based upon convective diffusion and mass flow, rather than the molecular-diffusional mechanism of Danckwerts. (K.S.)

INSTRUMENTS

5893

Phillips Petroleum Co., Atomic Energy Div.

TEMPERATURE CONTROLLER. G. L. Smith. Apr. 27, 1954. 11p. Contract AT(11-1)-205. (IDO-16137)

A temperature controller is described which was designed for use in applications where rapidly varying temperatures are experienced. This report gives the circuit design considerations, operation, adjustments, and applications of the controller. (auth)

5894

Naval Research Lab.

THE TW-10—A HIGH WRITING SPEED CATHODE-RAY TUBE WITH DISTRIBUTED DEFLECTION. R. V. Talbot and L. M. Johnson. May 25, 1954. 22p. (NRL-4377)

The design and development of a cathode-ray tube to be used in the recording of high-speed nonrecurrent transients with good time and amplitude resolution is described. High deflection sensitivity with low transit-time distortion was achieved by the use of a distributed deflection system on the signal axis, as in the TW-9 cathode-ray tube developed previously. Improved time resolution was obtained by the combination of a small spot size and a large field on the time axis. The tube achieves a writing speed in excess of 10^{11} trace widths per second with a deflection factor of about 0.7 volts per trace width on the signal axis and a field of about 500 trace widths on the time axis. The distributed deflector has an effective transit time of about 1.7×10^{-10} seconds and an impedance of 52 ohms. The tube is particularly adapted to use in recording systems where signal transfer is obtained through coaxial transmission lines. Performance characteristics are listed, and records are shown of non-recurrent signals of millimicrosecond duration. (auth)

5895

A CAPILLARY VISCOMETER WITH CONTINUOUSLY VARYING PRESSURE HEAD. Samuel H. Maron, Irvin M. Krieger, and Arthur W. Sisko (Case Inst. of Tech., Cleveland, Ohio). *J. Appl. Phys.* 25, 971-6(1954) Aug.

A new capillary viscometer has been designed to study the flow behavior of non-Newtonian fluids. The instrument is convenient, absolute, and accurate, and covers continuously a wide shearing stress range in a single determination. A falling mercury column forces the sample through the capillary. Measurement of the column height as a function of time gives both pressure drop and flow rate. Provision is also made for the use of driving fluids less dense than mercury for measurements at lower shearing stresses. The density of the sample need not be determined. Methods and illustrations are given of the application of the new instrument to the determination of the absolute viscosities of Newtonian liquids, and the flow curves of non-Newtonian fluids. (auth)

5896

ON THE CHROMATIC FIELD ABERRATION OF THE MAGNETIC ELECTRON LENS IN THE ELECTRON MICROSCOPE. Nozomu Morito (Hitachi Central Research Lab., Tokyo, Japan). *J. Appl. Phys.* 25, 986-93(1954) Aug.

The chromatic field aberration of the magnetic lens in the electron microscope is theoretically studied. Good results are obtained for the coefficient of the chromatic difference in magnification of the objective, taking into account the inclination of the principal illuminating rays. The same coefficient of the intermediate lens increases rapidly as the magnification is reduced by the intermediate lens. The calculated results agree well with experimental results. Calculated results are given for the coefficients of chromatic difference in rotation of all lenses as well as for the coefficient of chromatic difference in magnification of the projection lens. (auth)

ISOTOPES

5897

ISOTOPE DETERMINATION BY THE GOLD ABSORPTION METHOD. M. Ferro (Northwestern Univ., Evanston, Ill.). *Z. Physik* 138, 441-8(1954) July 22. (In German).

A fast and simple method is described for the identification of β -emitting isotopes. Activities as low as 50 $\mu\mu\text{C}$ can be identified with this method. The method depends on the empirical condition that the absorption of β particles in materials of high atomic number proceeds exponentially and that the absorption coefficient of Au is inversely proportional to the $3/2$ power of the maximum energy on the β spectrum. The absorption coefficient of Au, in addition to the half life period and the maximum energy, can be considered as a further indication of β emitters. The application of the method to the qualitative and quantitative analysis of isotopic mixtures is described. (tr-auth)

MASS SPECTROGRAPHY

5898

Florida Univ. Coll. of Engineering, Engineering and Industrial Experiment Station

A SLOW LINEAR MAGNETIC SWEEP CIRCUIT. Bruno F. Ludovici. June 1954. 55p. Contract DA-01-009-ORD-370. (NP-5278)

A circuit for an automatic field sweep in mass spectrom-

eters is described. With the magnet used in this thesis a field intensity of 4000 gauss is reached after a sweep duration approximately adjustable from one minute to ten minutes. The sweep is linear with an accuracy of better than 1% over the entire range. No moving parts are used. The circuit uses a standard sawtooth generator consisting of a large capacitance charged through a saturated pentode, in connection with a linear d-c amplifier for the magnet current. A small induction coil is located in the air gap of the magnet. The nonlinear relationship between magnet current and magnetic field is compensated for by the induced voltage in the coil, which controls the charge rate of the capacitance. Thus the sawtooth shape of the magnet current function is so distorted that the induced voltage, i.e., the first time derivative of the magnetic field, remains constant with an actuating error of less than 1%. (auth)

MATHEMATICS

5899

Ballistic Research Labs., Aberdeen Proving Ground
ON THE STUDY OF COMPUTATIONAL ERRORS. Saul Gorn. May 1952. 44p. (BRL-816)

The effect of the "logical flow chart" of a computational procedure is shown on the kinds of error that must be computed if the influence of errors in the input data and accumulating round-off is to be kept under control. Four distinct basic cases on which the efficiency of high speed digital computers depends are analyzed. (auth)

5900

AUTOMATIC DIGITAL COMPUTATION. Proceedings of a Symposium held at the National Physical Laboratory, Teddington, England, on March 25-28, 1953. London England, Her Majesty's Stationery Office, 1954. 296p. \$4.75.

MEASURING INSTRUMENTS AND TECHNIQUES

5901

Mound Lab.

ABSOLUTE ALPHA COUNTING II: STANDARD LOW-GEOMETRY CHAMBER. M. L. Curtis, R. G. Olt, and J. F. Eichelberger. May 7, 1953. 14p. Contract AT-33-1-GEN-53. (MLM-843)

The Logac (low-geometry alpha counter is evaluated for routine assay of solutions of high α activity when used with the standard low-geometry chamber. The standard low-geometry chamber was designed and built so that it could be so accurately measured that over-all errors in its geometric calibration would not exceed 0.30%. It is used as an absolute alpha counter to evaluate standards which are in turn used for the radiometric calibration of the Logacs. Three independent checks indicate that the desired accuracy was achieved. (auth)

5902

Mound Lab.

A NONLINEAR PULSE AMPLIFIER OF WIDE DYNAMIC RANGE. W. H. Baker. May 5, 1953. 18p. Contract AT-33-1-GEN-53. (MLM-851)

An amplifier usable for the full range of pulses developed in a windowless proportional chamber using absorbers is described. Its sensitivity is approximately 50 μV , and its dynamic range is greater than 6,000. Unusual features of this amplifier are its simple gain compression circuit of

less than 3-ma current drain and a 1,000-ohm chamber load resistor. (auth)

5903

De Paul Univ.

SCINTILLATION TECHNIQUES APPLIED TO ELECTRON ENERGY STUDIES. QUARTERLY PROGRESS REPORT NO. 8 [FOR] JANUARY 1, 1954 TO JUNE 30, 1954.

Edwin J. Schillinger, Jr. 37p. Contract DA-36-039-sc-15505. (NP-5280)

5904

USE OF X-RAY FILM FOR COMPARING RADIOACTIVITIES. A. N. Davenport and G. W. W. Stevens (Kodak, Ltd., Harrow, Middlesex, England). *Nature* 174, 178-9(1954) July 24.

A comparison was made of the accuracy obtained with a counter and with x-ray film when used for comparing the radiation per unit area from a number of different sources. It is shown that autoradiography by density measurements gives results comparable to counting, and even by visual inspection it gives a semi-quantitative value. (J.S.R.)

5905

THE RANGE OF USEFULNESS OF PHOTOGRAPHIC FILM IN ROENTGEN DOSIMETRY. Gerald J. Hine (Massachusetts Inst. of Tech., Cambridge). *Am. J. Roentgenol. Radium Therapy Nuclear Med.* 72, 293-301(1954) Aug.

Some of the problems connected with the application of photographic film for dosage measurements of x and γ radiation are discussed. Such factors as photographic film density, film response to electrons, and film response to secondary electrons produced by x and γ radiation are included. (L.T.W.)

5906

THE FILM METHOD OF TISSUE DOSE STUDIES WITH 2.0 Mev ROENTGEN RAYS. R. C. Granke, K. A. Wright, W. W. Evans, J. E. Nelson, and J. G. Trump (Massachusetts Inst. of Tech., Cambridge). *Am. J. Roentgenol. Radium Therapy Nuclear Med.* 72, 302-7(1954) Aug.

The photographic film method of studying radiation dose distribution possesses advantages of simplicity and wealth of quantitative information when used with x rays in the 1 to 20 Mev range in which the Compton process of interaction with tissue predominates. As compared with ionization chamber measurements, the photographic film, when parallel to the incident beam, will indicate somewhat higher ionization density at considerably greater depths in tissue because of the film dependence on x-ray quality and other factors. Normal orientation of the film with respect to x-ray beam produces the most accurate results. The parallel orientation is permissible and usually more convenient. For the latter, correlation with ionization chamber measurements will produce results which are well within the limits of tolerance for applications to therapy. Radiation film technique is less suitable to lower voltages where photoelectric absorption is important because of its strong dependence on atomic number and because of the short range of the secondary electrons. (auth)

5907

THE ROLE OF PAROGALLOL IN THE DEVELOPMENT OF NUCLEAR EMULSIONS. Arlette Bonnet. *J. phys. radium* 15, 587-8(1954) July-Aug.-Sept. (In French).

The addition of parogallol to hydroquinone in the development of nuclear emulsions allows the homogeneous development of thick plates at a slow rate without fogging the plate. (J.S.R.)

5908

APPLICATION OF A NUCLEAR PHOTOGRAPHIC PLATE TO THE MEASUREMENT OF THE RADIOACTIVITY OF LIQUIDS. René Coppens. *J. phys. radium* 15, 588-9(1954) July-Aug.-Sept. (In French).

Nuclear plates can be used to measure the radioactivity of liquids if the plate is protected by a very thin coat of celluloid. The coating is easily passed by α particles and does not affect the development of the plate. (J.S.R.)

5909

SMALL-DIAMETER GEIGER-MÜLLER COUNTERS WITH EXTERNAL CATHODE. Daniel Blanc (Coll. de France, Paris). *J. phys. radium* 15, 590-1(1954) July-Aug.-Sept. (In French).

Some characteristics of small diameter Geiger-Mueller tubes with external cathode are described. The tubes have an interior diameter of 5 mm. (J.S.R.)

5910

OPTIMUM SHAPE FOR CYLINDRICAL IONIZATION CHAMBERS. R. K. Clark and S. S. Brar (Argonne National Lab., Lemont, Ill.). *Nucleonics* 12, No. 8, 28-9(1954) Aug.

Correction factors for geometry are derived to permit calculations of true ionization density from chamber readings with source on chamber axis. Minimum corrections are required when ratio of cylinder height to diameter is 0.75 or 0.80. (auth)

5911

FAST-NEUTRON DOSE IN A LARGE TISSUE-EQUIVALENT PHANTOM. T. A. Barr and G. S. Hurst (Oak Ridge National Lab., Tenn.). *Nucleonics* 12, No. 8, 33-5(1954) Aug.

Good agreement is found between dose rates obtained when irradiating a large phantom with a Po-B point source and those calculated by Snyder and Neufeld. An empirical exponential equation is given to express the dose rate. (auth)

5912

FAST-NEUTRON SCATTERING: A CORRECTION FOR DOSIMETRY. John W. Cure and G. S. Hurst (Oak Ridge National Lab., Tenn.). *Nucleonics* 12, No. 8, 36-8(1954) Aug.

Applicable to neutron-dosimeter calibration in air, the inverse square law predicts dose rate for source-to-detector distances of 20 to 150 cm. Measurements at various heights above concrete agree with albedo-theory curve. (auth)

5913

SIMPLIFIED FILM PROCESSING FOR RADIATION DOSIMETRY. R. J. Magill (Univ. of California, Berkeley). *Nucleonics* 12, No. 8, 43-4(1954) Aug.

5914

GAMMA COUNTING EFFICIENCY OF TWO WELL-TYPE NaI CRYSTALS. R. Baskin, H. L. Demorest, and S. Sandhaus (Veterans Administration Hospital, Minneapolis, Minn.). *Nucleonics* 12, No. 8, 46-8(1954) Aug.

The efficiency of a scintillation counter incorporating a 2-in. by 2-in. NaI crystal with a well to accommodate a 20-cc sample vial is compared with the efficiency of a small well counter accommodating a 4 cc vial for counting radiation in low-activity samples encountered in medical and biological tracer work. (C.H.)

MESONS

5915

π -NUCLEON PRODUCTION IN π -NUCLEON COLLISIONS AT 1.5 BEV. W. D. Walker, J. Crussard, and M. Koshiba (Univ. of Rochester, N. Y.). *Phys. Rev.* **95**, 852-3(1954) Aug. 1.

The reactions $\pi^- + p \rightarrow \pi^+ + \pi^- + n$ and $\pi^- + p \rightarrow \pi^- + \pi^+ + p$ are found to have similar characteristics. The neutron usually goes backward in the c.m. system with an average momentum of 500 Mev/c, and the average angular distribution of π^- and π^0 is similar to π^+ and π^- , about 135° in the c.m. system. A forward peak in the angular distribution is evident, consisting mostly of fast mesons, whereas slower mesons are concentrated in a backward peak. A number of $\pi^- n$ interactions occurring on the edge of a nucleus are discussed. It is concluded that the angular distribution between the two π mesons in the c.m. system is consistent with the excited-nucleon model. (K.S.)

5916

PHOTOPION S WAVE NEAR THRESHOLD AND THE PION NUCLEON COUPLING CONSTANT. G. Bernardini and E. L. Goldwasser (Univ. of Illinois, Urbana). *Phys. Rev.* **95**, 857-8(1954) Aug. 1.

Photoproduction of π^+ mesons near threshold from H_2 at 90° c.m. angle is investigated. An expression for the photoproduction cross section at threshold is derived, and from available data for D_2 , it is shown that the coupling constant has a value of $f^2 = 0.066 \pm 0.008$. (K.S.)

5917

DECAY CURVE OF K PARTICLES. L. Mezzetti and J. W. Keuffel (Princeton Univ., N. J.). *Phys. Rev.* **95**, 858-60 (1954) Aug. 1.

The decay curve of stopped unstable cosmic-ray particles was measured by a system of liquid scintillators and Cherenkov counters arranged in such a way as to measure only those decays which produce relativistic secondaries. A discussion of the experimental method for biasing the response of the equipment to long-range μ mesons from K decay is given, and from the resulting measurement of time lag distributions, a mean life of $8.7 \pm 1.0 \mu\text{sec}$ is obtained. (K.S.)

5918

MESON PRODUCTION IN n-p COLLISIONS AT COSMOTRON ENERGIES. W. B. Fowler, R. P. Shutt, A. M. Thorndike, and W. L. Whittemore (Brookhaven National Lab., Upton, N. Y.). *Phys. Rev.* **95**, 1026-44(1954) Aug. 15.

154 analyzable three-prong events were observed in collisions between Cosmotron-produced neutrons, with energies up to 2.2 bev, and protons in a hydrogen-filled diffusion cloud chamber. These events were classified as a result of the reactions $n + p \rightarrow p + p + \pi^-$, $p + p + \pi^- + \pi^0$, and $p + n + \pi^+ + \pi^-$ with frequencies in the ratio $(0.8 \pm 0.3): (1 \pm 0.35): (3.2 \pm 0.7)$, respectively. The observed ratio of the probability for double meson production to that for single meson production is more than 20 times higher than the ratio predicted from Fermi's statistical model. No triple meson production is observed, in agreement with the statistical model. The momentum distributions of the observed mesons are also in rough agreement with the theory. In the center-of mass system, in the reaction $n + p + \pi^+ + \pi^-$, protons and π^+ show a tendency to be emitted backward, while neutrons and π^- tend towards forward emission. However, the data suggest that protons and π^+ , and also neutrons and π^- , tend to be emitted more frequently in opposite directions than protons and π^- or neutrons and π^+ . All of these results may be

qualitatively in agreement with a meson production model where each nucleon is excited separately to an intermediate, possibly resonant, state which subsequently decays by emission of a meson. (auth)

MOLECULAR PROPERTIES

5919

THERMOMAGNETIC STUDY OF THE FERRITES OF DYSPROSIUM AND ERBIUM. Georges Guilot-Guillain, René Pauthenet, and Hubert Forestier. *Compt. rend.* **239**, 155-7 (1954) July 12. (In French).

A precise thermal analysis of the magnetic properties of the ferrites of Dy and Er confirms the previous result with Gd ferrite, establishing beyond doubt the existence of a compensation temperature at which the spontaneous magnetization changes sign. (tr-auth)

5920

PARAMAGNETIC RESONANCE ABSORPTION IN A SOFT CARBON. J. G. Castle, Jr. (Univ. of Buffalo, N. Y.). *Phys. Rev.* **95**, 846-7(1954) Aug. 1.

An investigation of the magnetic resonance properties of carbons and graphite at room temperature revealed that the width of the electronic spin resonance absorption characteristic of a soft carbon powder varies with the heat treatment of the powder. The variation suggests the existence of a physical correlation between the width of the spin resonance absorption and the Hall coefficient. (K.S.)

5921

A METHOD OF DETERMINING THE ELECTRONIC TRANSITION MOMENT FOR DIATOMIC MOLECULES. P. A. Fraser (Univ. of Western Ontario, London, Ontario, Canada). *Can. J. Phys.* **32**, 515-21(1954) Aug.

A method is described that will give the variation, as a function of internuclear distance, of the electronic transition moment governing intensities in diatomic molecular band systems. Reliable theoretical results and good experimental intensities are used conjointly to find this variation. Once smoothed, the trend may be replaced into the overlap integrals to give relative vibrational transition probabilities better than those given by the approximation 'overlap integrals squared', and presumably better than those deduced directly from experiment, since the latter are not smoothed. Limits on the application of the method are suggested; however, many band systems fall within these limits. (auth)

NEUTRONS

5922

STUDY OF THE DIFFUSION OF NEUTRONS IN A LEAD SPHERE BY THE MONTE CARLO METHOD. J. M. Tharrats, J. M. López Roca, and V. Herrero Climent. *Anales real soc. espan. fis. y quim. (Madrid)* **50**(A), 107-18 (1954) May-June. (In Spanish).

As an application of the Monte Carlo method to nuclear physics problems, diffusion of neutrons emitted by a Ra-Be source in a Pb sphere of 7-cm radius was studied. In this way, the primary and secondary spectra of both elastic and inelastic collisions were obtained. For these calculations, the random digits sequence, attained directly from the compound electronic roulette 2PA type, was used. The study comprises seven hundred and fifty neutrons. (auth)

NUCLEAR PHYSICS

5923

HIGH-ENERGY, LARGE-ANGLE DISTRIBUTION OF PAIR

ELECTRONS PRODUCED BY BREMSSTRAHLUNG. R. C. Miller (Univ. of Illinois, Urbana). *Phys. Rev.* **95**, 796-8 (1954) Aug. 1.

The results of a calculation of the number of high-energy pair particles emitted into large angles in a pair production process initiated by bremsstrahlung are tabulated. A very approximate estimate of the effect of nuclear screening is given. (auth)

NUCLEAR PROPERTIES

5924

Argonne National Lab.

THE NEUTRON CAPTURE CROSS SECTION OF ERBIUM ISOTOPES. Raymond F. Barnes. July 1954. 6p. Contract W-31-109-eng-38. (ANL-5287)

The capture cross section of Er^{168} as determined from the yield and decay of Er^{169} produced by a (n, γ) reaction on Er^{168} was found to be 2.03 ± 0.41 barns. The cross section determined for Er^{170} (8.72 ± 1.78 barns) is the sum of the cross sections for the formation of an isomeric state of Er^{171} by a (n, γ) reaction on Er^{170} and the ground state of Er^{171} , since the isomer with 2.5-sec half life completely decayed to the ground state (7.5-hr half life) by the time of measurement. Gold was used as a flux monitor. A Cd-shielded and an unshielded Au foil were irradiated along with the Er to obtain the thermal flux. (J.A.G.)

5925

FURTHER CALCULATIONS ON THE NUCLEAR RESONANCE SPECTRUM OF Al^{27} IN SPODUMENE. G. M. Volkoff and G. Lamarche (Univ. of British Columbia, Vancouver). *Can. J. Phys.* **32**, 493-7(1954) Aug.

Calculations of the expected dependence of the relative intensities of nuclear quadrupole resonance lines of Al^{27} on the orientation of a single crystal of spodumene, with respect to a linearly polarized resonant magnetic field H_1 , show that a suitably oriented single crystal should give rise to lines which are approximately twice as strong as those in a randomly oriented polycrystalline sample. The dependence of the matrix elements, which determine expected nuclear magnetic resonance line intensities, on the strength of a uniform external magnetic field H_0 is also given for one particular crystal orientation with respect to both H_0 and a linearly polarized field H_1 . (auth)

5926

ENERGY OF THE FIRST EXCITED LEVEL OF Kr^{80} . Jeanne Laberrigue-Frolow and Nadine Marty (Coll. de France, Paris). *J. phys. radium* **15**, 584-5(1954) July-Aug.-Sept. (In French).

The β^- spectrum of Br^{80} in coincidence with the 620-kev γ ray was determined with a β spectrometer associated with a scintillation spectrometer. The Fermi straight line of the β^- spectrum in coincidence is given. Its total energy was calculated to be between 1300 and 1450 kev, much higher than the value obtained by other methods and the value of the first excited level of Kr^{80} . (J.S.R.)

5927

COULOMB ENERGIES OF LIGHT NUCLEI. D. C. Peaslee (Columbia Univ., New York). *Phys. Rev.* **95**, 717-23(1954) Aug. 1.

The Coulomb energy differences of light nuclei, determined mostly from β decay, are fitted to a formula $\Delta E_c = \alpha(Z/A^{1/2}) + b$, where b is an exchange term. With modern data, the nuclear series $A = 4n, 4n + 1, 4n + 2, 4n + 3$ all

yield surprisingly consistent values: $a = 1.46$ Mev, $b = -1.11$ Mev. The data very clearly exhibit the presence of the exchange term; the value of a corresponds to a square well radius, $R = 1.18A^{1/2} \times 10^{-13}$ cm. The ΔE_c formula is combined with β -decay energies to determine the spacing $\Delta_{TT'}$ of the lowest-lying states of isotopic spins T, T' for a given A . The observed behavior of the Δ provides qualitative evidence for dominant supermultiplet structure in light nuclei. (auth)

5928

EFFECT OF THE ATOMIC CORE ON THE NUCLEAR QUADRUPOLE COUPLING. R. M. Sternheimer (Brookhaven National Lab., Upton, N. Y.). *Phys. Rev.* **95**, 736-50(1954) Aug. 1.

The effect of the electron core on the nuclear electric quadrupole coupling has been evaluated for several atomic ground states and first excited states. The antishielding produced by the $np \rightarrow p$ and $nd \rightarrow d$ excitations of the core is taken into account in all cases. For the ground states, the effect of the angular modes of excitation predominates and gives a net shielding of the same order as that predicted by the Thomas-Fermi model, except for two cases of heavy atoms (Cs, W) where the antishielding predominates. For the first excited (p) states of the alkalis (except Li) there is a net antishielding which ranges from 10 percent for Na to 24 percent for Cs. Approximate values of the quadrupole correction factor are given for 9 atomic states. (auth)

5929

EFFECTS OF CERTAIN THREE-BODY NUCLEAR INTERACTIONS IN H^3 AND He^3 . A. W. Solbrig, Jr. (Vanderbilt Univ., Nashville, Tenn.). *Phys. Rev.* **95**, 831-6(1954) Aug. 1.

This limited, theoretical study is phenomenological and nonrelativistic. Effects of interactions on wave functions, magnetic dipole moments, and binding energies are obtained by first-order perturbation methods. The interactions satisfy well-known requirements of invariance, contain no power of momentum higher than the first, involve no dependence on charge, and introduce only P state in a first-order calculation. They contain spin-orbit interactions and may give rise to interaction moments. Each interaction contains a scalar radial function of positions f . The unperturbed potential corresponds to pairwise Hooke's law forces between nucleons. The first-order energy perturbation is shown to vanish for all the interactions. It is shown, without further specialization of the f , that no one of fifty-eight of the seventy-five interactions yields observed magnetic moments. No definite conclusion is obtained for eleven of the remaining seventeen interactions, for calculations with plausible f appear difficult. Each of the remaining six interactions yields observed magnetic moments with plausible f . (auth)

5930

ENERGY LEVELS OF Al^{26} . Cornelius P. Browne (Massachusetts Inst. of Tech., Cambridge). *Phys. Rev.* **95**, 860-1 (1954) Aug. 1.

5931

COULOMB EXCITATION OF ENERGY LEVELS IN RHODIUM AND SILVER. N. P. Heydenburg and G. M. Temmer (Carnegie Institution of Washington, D. C.). *Phys. Rev.* **95**, 861-3(1954) Aug. 1.

5932

GAMMA TRANSITIONS IN W^{182} . F. Boehm, P. Marmier, and J. W. M. DuMond (California Inst. of Tech., Pasadena). *Phys. Rev.* **95**, 864-5(1954) Aug. 1.

5933

TWO-BODY FORCES AND NUCLEAR STABILITY. David H. Frisch (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. 95, 865-6(1954) Aug. 1.

A comparison of calculated potential energies per particle in a nucleus according to Majorana, Serber, symmetric, and S wave interactions is undertaken in order to account for recent experimental evidence for a nuclear radius as small as $1.1 A^{1/3} \times 10^{-13}$ cm. The results with S wave and symmetric interactions indicate that a linear superposition of central two-body forces could give negative potential energies of sufficient magnitude to account for observed nuclear binding energies and at the same time give stability at small radii. (K.S.)

5934

POLARIZATION OF Mn^{55} NUCLEI: CRYOGENIC ASPECTS. J. W. T. Dabbs and L. D. Roberts (Oak Ridge National Lab., Tenn.). Phys. Rev. 95, 970-4(1954) Aug. 15.

A brief discussion of certain cryogenic aspects of nuclear polarization is given. This discussion is applied to Mn^{55} in the paramagnetic salt $Mn(ND_4)_2(SO_4)_2 \cdot 6D_2O$. Measurements on this salt of the temperature in the range $0.12 \leq T \leq 0.35^\circ K$, and of magnetic moment up to 90 percent of saturation as a function of magnetic field in the range $660 \leq H \leq 4560$ gauss, and for an entropy $S/R = 0.514$, are described. These measurements are used to calculate the nuclear polarization as a function of field in this magnetic field range and at this entropy, and they form the cryogenic basis for Mn^{55} polarization experiments reported previously. (auth)

5935

COULOMB RADIUS CONSTANT FROM NUCLEAR MASSES. Alex E. S. Green (Florida State Univ., Tallahassee). Phys. Rev. 95, 1006-9(1954) Aug. 15.

On the assumption of a uniform charge distribution, the Coulomb energy constant obtained from a recent adjustment of the semiempirical formula to the mass data corresponds to the Coulomb radius constant 1.237 (in 10^{-13} cm). This result is in good agreement with the radius constant obtained from recent studies of μ -mesonic x rays, and can be readily reconciled with the radii obtained from electron scattering, isotope shift measurements, and mirror nuclide mass differences. In view of the importance of the question of the Coulomb radius, an attempt is made to refine the determination of the Coulomb radius, an attempt is made to refine the determination of the Coulomb radius constant based upon nuclear masses by using an objective criterion for best fit. A least-squares analysis involving a new adjustment procedure yields the radius constant 1.216 . An investigation of the precision of this determination leads to the assignment of a probable error of 1 percent. This new radius constant agrees with the average radius constant obtained from μ -mesonic x rays within the small probable error assigned to each. (auth)

NUCLEAR REACTORS

5936

DEVELOPMENT OF THE SECOND FRENCH REACTOR. L. Kowarski (Commissariat à l'Énergie Atomique, Paris, France). Nucleonics 12, No. 8, 8-11(1954) Aug.

The history and objectives of the French Atomic Energy program are reviewed briefly, and the design, construction, operation, and contributions of the Saclay reactor in testing, physical research, and as a source of radiation are summarized. (C.H.)

5937

IN A HEAVY WATER REACTOR: HOW DO GAMMA RAYS AFFECT REACTIVITY? Arne Lundby (Joint Establishment for Nuclear Energy Research, Kjeller, Norway). Nucleonics 12, No. 8, 25-7(1954) Aug.

Gamma rays produced by neutron capture in a heavy-water reactor react with deuterium to produce more neutrons. The extent of this reaction and its effect on reactivity is discussed for structural and irradiated materials. (auth)

5938

EQUATIONS FOR HETEROGENEOUS REACTORS. Alejandro Medina. Rev. mex. fis. 3, 84-103(1954) Apr. (In Spanish).

By means of a systematic averaging process applied to a heterogeneous pile, it is possible to obtain a simple set of design equations giving good agreement with experiment for thermal reactors. Such a process is developed in this paper, where it is shown that by the use of suitable constants, the general behavior of a pile can be predicted within a very reasonable degree of accuracy. (auth)

5939

RESEARCH REACTOR PROGRAM AT THE PENNSYLVANIA STATE UNIVERSITY. William M. Breazeale (Pennsylvania State Univ., State College). NUCLEAR ENGINEERING, PART II, Chem. Eng. Progr. Symposium Ser. No. 12, 6-10 (1954).

The design of the Penna. State Univ. facility is described and illustrated. The reactor is similar to the ORNL Bulk Shielding Facility except that one end of the concrete tank is exposed to accommodate several horizontal beam holes. (L.T.W.)

5940

A HIGH PERFORMANCE RESEARCH REACTOR. Joseph P. Gill (Oak Ridge National Lab., Tenn.). NUCLEAR ENGINEERING, PART II, Chem. Eng. Progr. Symposium Ser. No. 12, 43-58(1954).

The high-performance research reactor at Oak Ridge National Lab. will provide the highest thermal neutron flux per dollar invested. Designed as a 10-Mw reactor, the facility incorporates a heterogeneous core utilizing enriched U as fuel and light water as coolant-moderator. The reflector may be a thin layer of Be or BeO backed by a thick layer of light water. The building and related facilities and the cooling systems are described. Cost estimates are included. (L.T.W.)

5941

A NUCLEAR REACTOR FOR METALLURGICAL RESEARCH. J. J. O'Connor and L. S. Foster (Watertown Arsenal, Mass.). NUCLEAR ENGINEERING, PART II, Chem. Eng. Progr. Symposium Ser. No. 12, 59-62(1954).

A reactor that has been designed specifically for research utilizing neutrons in the fields of metallurgy and solid-state physics is described. The reactor, which is similar to the ORNL Bulk Shielding Facility, is thermal, heterogeneous, water moderated and cooled, and BeO reflected and employs enriched U fuel rods. The reactor is designed to operate initially at 100 kw, later to be raised to 1000 kw with minor alterations. (L.T.W.)

5942

THE ROLE OF EXPONENTIAL EXPERIMENTS IN REACTOR DESIGN. E. R. Cohen (North American Aviation, Inc., Downey, Calif.). NUCLEAR ENGINEERING, PART II, Chem. Eng. Progr. Symposium Ser. No. 12, 72-81(1954).

Theoretical and practical considerations involved in carrying out exponential experiments for possible reactor designs are discussed. (L.T.W.)

5943

APPLICATION OF ANALOG COMPUTING TECHNIQUES TO THE SOLUTION OF NEUTRON-FLUX DISTRIBUTION PROBLEMS. H. C. Honeck and D. G. Ott (Pratt and Whitney Aircraft, East Hartford, Conn.). *NUCLEAR ENGINEERING, PART II, Chem. Eng. Progr. Symposium Ser. No. 12*, 107-12 (1954).

Numerical solution, by analog computing techniques, of the Boltzmann neutron diffusion equation is described in detail. (L.T.W.)

5944

A COMPARATIVE EVALUATION OF SOME COOLANTS FOR POWER REACTORS. T. T. Shimazaki (North American Aviation, Inc., Downey, Calif.). *NUCLEAR ENGINEERING, PART II, Chem. Eng. Progr. Symposium Ser. No. 12*, 113-19 (1954).

A comparison of power cost for some coolants that can be used in a graphite-moderated fixed solid fuel reactor of a central station steam power plant is presented. Power costs for Na, Bi, Pb-Bi eutectic, and $\text{NaHO}_2\text{-NaNO}_3\text{-KNO}_3$ mixture are comparable. If an intermediate cooling system is not required, power cost for Pb-Mg eutectic is somewhat lower than for Na. (L.T.W.)

NUCLEAR TRANSFORMATION

5945

Kentucky Univ.

STUDY OF NUCLEAR ENERGY LEVELS. FINAL REPORT. Thomas M. Hahn and Bernard D. Kern. Aug. 31, 1954. 69p. Contract DA-33-008-ord-556. (NP-5285)

The γ -ray yield from proton bombardment (0 to 1 Mev) of B^{11} was measured. Angular distributions of 12- and 16-Mev γ radiation from thick target interactions were also investigated. Other data were obtained on the proton bombardment of F_2 , NaF , and TaF_5 . A high-current, positive-ion accelerator was constructed to serve as a source of fast neutrons. This device is used to obtain the γ spectra of Fe, Cu, Al, Mg, and Ag. (K.S.)

5946

CROSS SECTIONS FOR THE REACTIONS $\text{Ti}^{48}(\text{d},2\text{n})\text{V}^{48}$; $\text{Cr}^{52}(\text{d},2\text{n})\text{Mn}^{52}$; AND $\text{Fe}^{56}(\text{d},2\text{n})\text{Co}^{56}$. Warren H. Burgus, George A. Cowan, J. W. Hadley, Wilnot Hess, Theodore Shull, M. L. Stevenson, and H. F. York (Univ. of California, Livermore). *Phys. Rev.* 95, 750-1 (1954) Aug. 1.

Measurements have been made of the (d,2n) cross sections of the nuclear species Ti^{48} , Cr^{52} , and Fe^{56} . Results are given for incident deuterons in the energy region 1 to 20 Mev. (auth)

5947

COULOMB EXCITATION OF Ta, W, AND Au. W. I. Goldberg and R. M. Williamson (Duke Univ., Durham, N. C.). *Phys. Rev.* 95, 767-71 (1954) Aug. 1.

By using protons as bombarding particles, a study has been made of the yields and angular distributions of Coulomb-excited gamma rays in tantalum (137, 166, 303 kev), tungsten (114 kev), and gold (277, 195, 545 kev). Coincidence experiments show that the 277-kev and the previously unreported 545-kev transition go to the ground state and that the Ta 166-kev line represents a cascade from 303 kev. Thin-target yield data for the 277-kev gamma gives an absolute cross

section which is in approximate agreement with the theory while the absolute cross section for the 545-kev transition is seven times too large. In both cases the experimental cross sections increase more rapidly than the theory. Thick-target yields from the five strongest gamma rays are greater than the theory by factors ranging from 6 to 100 percent between proton energies of 2 and 4 Mev. Agreement with the theory becomes worse with increasing level energy and decreasing proton energy. On the basis of the theory the angular distribution data permit an unambiguous spin assignment of $\frac{1}{2}$ to the 545-kev level and give agreement with the previously established spins for the 277 (Au), 137, 303 (Ta), and 114-kev (W) levels. The ratio of E2 to M1 radiation is $7_{-5}^{+13}/100$ for the 277-kev radiation (Au) and less than 5/100 for the 137-kev radiation (Ta). (auth)

5948

PHOTONEUTRON CROSS SECTIONS IN He, N, O, F, Ne, AND A. G. A. Ferguson, J. Halpern, R. Nathans, and P. F. Yergin (Univ. of Pennsylvania, Philadelphia). *Phys. Rev.* 95, 776-80 (1954) Aug. 1.

The direct detection of neutrons from (γ ,n) reactions induced by betatron bremsstrahlung has been applied to cross-section determinations using gaseous targets at approximately 100 atmospheres pressure. Results from oxygen are consistent with other determinations. The remaining elements represent new results and show the familiar giant dipole resonance for the photoneutron process. Parameters of the resonances are determined and related to the systematic behavior previously reported for other elements. (auth)

5949

RESONANT STATES OF Mg^{24} EXCITED BY PROTONS ON SODIUM. P. H. Stelson and W. M. Preston (Massachusetts Inst. of Tech., Cambridge). *Phys. Rev.* 95, 974-81 (1954) Aug. 15.

The gamma-ray yield from sodium was measured as a function of proton bombarding energy over the range 1.0 to 2.5 Mev, using resolutions of 2.5 kev or better. In addition, the yield of α particles produced by the $\text{Na}^{23}(\text{p},\alpha)\text{Ne}^{20}$ reaction and leading to the ground state of the residual nucleus was measured for proton energies of 1.0 to 2.2 Mev, with a resolution of 10 kev. Fifty-two resonances were observed in all. The resulting average level spacing is 28 kev at a mean excitation energy of 13.5 Mev in the compound nucleus Mg^{24} . The resonances vary in natural width from less than 0.3 kev to 50 kev. The energy spectra of the gamma rays from a number of resonances were investigated with a single-crystal $\text{NaI}(\text{Ti})$ scintillation spectrometer. The spectra consist mainly of two gamma rays with energies of 0.45 ± 0.01 and 1.63 ± 0.02 Mev. These are interpreted as transitions from the first excited states of the residual nuclei formed by the reactions $\text{Na}^{23}(\text{p},\text{p}')\text{Na}^{23}$ and $\text{Na}^{23}(\text{p},\alpha')\text{Ne}^{20}$, respectively. (auth)

5950

REORIENTATION OF ALIGNED NUCLEI. N. R. Steenberg (National Research Council, Ottawa, Canada). *Phys. Rev.* 95, 982-8 (1954) Aug. 15.

Where nuclei aligned at low temperatures decay by a two-stage cascade, the degree of alignment of the intermediate state may be influenced by magnetic coupling. If the second stage is γ radiation, the angular distribution will be influenced as a consequence. This effect is treated by assuming a static interaction and twofold ionic degeneracy. In particular for high temperatures very explicit results are given for Δ' , the mean degree of alignment of the intermediate state.

This is dependent primarily on the mean life and magnetic moment of the intermediate state. It is found that if the properties of the intermediate state are similar to those of the initial state: (1) reorientation effects will be present if $\tau > 10^{-9}$ sec; (2) they may either increase or decrease Δ' ; (3) a strong external field cancels the effect altogether; (4) reorientation can introduce $\cos^4\theta$ terms into the angular distribution even at the highest temperatures; (5) where τ is very long, Δ' tends to a finite limit. The calculations are applied to an experiment. (auth)

5951

CONSERVATION OF ISOBARIC SPIN IN THE REACTION $\text{Be}^9(p,\alpha)\text{Li}^6$. R. Malm and D. R. Inglis (Argonne National Lab., Lemont, Ill.). *Phys. Rev.* 95, 993-9(1954) Aug. 15.

The reaction $\text{Be}^9(p,\alpha)\text{Li}^6$ involves transitions to the ground state and first excited state of Li^6 which are shown to display only a gradual dependence on proton energy and no indication of resonance at the known gamma-ray resonance at 2.565 Mev which goes by way of the second excited state of Li^6 . This may be explained in terms of conservation of isobaric spin and verifies that the second excited state of Li^6 has isobaric spin $T = 1$ (or odd charge parity) as does also the resonant state of the compound nucleus B^{10} . The lack of resonance in the two alpha groups does not provide a very sensitive test of the purity of isobaric spin in the resonant state, because the contribution of an impurity would be superposed on a background, but the sharpness with which the gamma resonance falls off on the low-energy side does indicate that neighboring $T = 0$ states have remarkably little $T = 1$ admixture. The observations were made by means of a 16-in. two-dimensional focusing magnetic spectrometer, the construction and characteristics of which are described.

(auth)

5952

RELATIVE PHOTOFISSION YIELDS OF SEVERAL FISSIBLE MATERIALS. J. R. Huizenga (Argonne National Lab., Lemont, Ill.) and J. E. Gindler and R. B. Duffield (Univ. of Illinois, Urbana). *Phys. Rev.* 95, 1009-11(1954) Aug. 15.

Relative photofission yields of U^{238} , U^{236} , U^{235} , U^{234} , U^{233} , Th^{232} , Np^{237} , and Pu^{239} were measured at three betatron energies with a photomultiplier fission-fragment detector. Results at betatron energies of 17 and 20 Mev are in agreement and give the following relative fission values: Th^{232} , 0.31; U^{238} , 1.00; U^{236} , 1.43; U^{235} , 2.40; U^{234} , 1.82; U^{233} , 2.54; Np^{237} , 2.40; Pu^{239} , 3.17. The relative (γ, f) yields are empirically correlated with the nuclear parameter Z^2/A . Some comments are made on the competition between fission and neutron emission. (auth)

PARTICLE ACCELERATORS

5953

[European Council for Nuclear Research]

FURTHER CONTRIBUTIONS TO THE THEORY OF LINEAR DISTURBANCES OF THE BETATRON OSCILLATIONS IN A C. G. SYNCHROTRON. G[erhart] Lüders. July 1953. 18p. (CERN-PS/GL-6)

The behavior of the betatron oscillations near the "stop bands" and the effect of simultaneous action of both "f-type" and "n-type" disturbances are analyzed. (auth)

5954

[European Council for Nuclear Research]

STATISTICAL ANALYSIS OF CLOSED ORBIT AND STOP

BANDS. G[erhart] Lüders. July 1953. 23p. (CERN-PS/GL-8)

The probability distributions of quantities characteristic of the properties of the closed orbit and the stop bands (due to linear disturbances of the betatron oscillations) are calculated and discussed. The questions of the fluctuation of the peak amplitude of the closed orbit along the circumference and of the influence of the subdivision of sectors are discussed. (auth)

5955

[European Council for Nuclear Research]

LECTURE ON ORBITS IN THE STRONG FOCUSING SYNCHROTRON. (DELIVERED AT SACLAY, MAY 21, 1953). J. B. Adams and F. K. Goward. 26p. (CERN/PS/JBA-FKG-1)

Conventional and strong-focusing methods are compared, and developments in the strong-focusing method are described. Only the motion of particles circulating at constant energy in static magnetic fields is considered. No problems associated with oscillations of the particles in energy or phase due to acceleration are included. (L.T.W.)

5956

[European Council for Nuclear Research]

MOMENTUM COMPACTION RELATIONSHIP IN THE NEW TYPE SYNCHROTRON WITH STRAIGHT SECTIONS.

Kjell Johnsen. Oct. 9, 1952. 8p. (CERN-PS/KJ-10)

It is shown that the straight sections have a favorable effect on the synchrotron oscillations. For example, the critical n-value for the 30-bev machine with 100-m radius is only 3650 if 0.5-m straight sections are inserted, whereas the corresponding figure would be 5280 if there were no straight sections. (auth)

5957

[European Council for Nuclear Research]

PHASE OSCILLATIONS. Kjell Johnsen. Nov. 3, 1952. 8p. (CERN-PS/KJ-11)

The differential equation for the phase oscillations is given, and it is shown that below a certain particle energy the stable point is in front of the peak of the accelerating wave, as in linear accelerators, whereas above this energy the stable point is behind the peak of the wave, as in ordinary synchrotrons. The frequency of small phase oscillations is also found. As would be expected, this frequency tends to zero when the particle energy tends to the transition energy. The amplitude of the radial synchrotron oscillations is found, and it is shown that this is very small close up to the critical energy. (auth)

5958

[European Council for Nuclear Research]

SFS WITH COMPENSATING SECTIONS TO MAKE UP FOR CHANGES IN THE FIELD INDEX. Kjell Johnsen. Feb. 16, 1953. 7p. (CERN-PS/KJ-15)

Two arrangements have been studied, one with the compensating sections between + and - sections and one with the compensating sections in the middle of the main sections. The former arrangement seems to give insufficient compensation, whereas the latter one looks promising. Variations of 10 to 15% in the n-value can fairly easily be adjusted for. (auth)

5959

[European Council for Nuclear Research]

FREQUENCY AND MOMENTUM TOLERANCES AT INJECTION. Apr. 27, 1953. 3p. and SUPPLEMENT TO

CERN-PS/KJ-18. May 4, 1953. 1p. Kjell Johnsen. 4p. (CERN-PS/KJ-18)

The necessary tolerances in frequency and momentum at the time the r-f system is switched on is discussed. The main result is that the relative frequency or momentum error that may be tolerated is inversely proportional to the square root of the multiple of the rotational frequency on which the r-f system is working, which may prove to be one of the upper limitations on M. The results obtained are valid for sudden frequency changes later in the accelerating cycle. (auth)

5960

[European Council for Nuclear Research]

A DISCUSSION OF THE PHASE EQUATION IN THE NEIGHBORHOOD OF THE TRANSITION ENERGY. Kjell Johnsen. June 12, 1953. 6p. (CERN-PS/KJ-21)

The phase equation of the strong-focusing synchrotron is developed. It is shown that the radial oscillation, in spite of the strong damping of the phase oscillation, tends to become infinite as the transition energy is approached. Apparently the amplitude in the region where the adiabatic approximation is valid does not increase to a dangerous value. The maximum radial amplitude at injection will probably always be larger. (L.T.W.)

5961

[European Council for Nuclear Research]

INVESTIGATION OF NON-LINEAR ORBIT THEORY. June 1954. 17p. (CERN-PS/RH-1)

5962

European Council for Nuclear Research

ORBIT INSTABILITIES IN THE NEW TYPE SYNCHROTRON. (LINEAR APPROXIMATION). Gerhart Lüders. Mar. 1953. 21p. (CERN-T/GL-4)

The two types of disturbances, which can occur in the linear approximation of the field and the equations of motion, are pointed out, and the resonance difficulties to which they can give rise are analyzed. (auth)

5963

Radiation Lab., Univ. of Calif., Berkeley

A 90-INCH CYCLOTRON WITH AN ADJUSTABLE-ENERGY EXTERNAL BEAM. Bob H. Smith. June 9, 1954. 20p. Contract W-7405-eng-48. (UCRL-2620)

The 90-inch cyclotron under construction at Livermore, California is intended to produce a large external beam which may be tuned through the following ranges: protons—4 to 15 Mev; deuterons—4 to 12.5 Mev; tritons—7.5 to 8.5 Mev. The design of the dee and resonator, magnet, electronic equipment, and plant layout is described. (auth)

5964

A SYSTEM OF A POTENTIAL STABILIZER FOR ACCELERATORS OF CHARGED PARTICLES. Eduardo Díaz Losada, Alonso Fernández, and Luis Velázquez (Universidad Nacional de México, Mexico City). *Rev. mex. fis.* 3, 115-22(1954) Apr. (In Spanish).

An electronic system is described which improves the establishment of the potential in the terminal of electrostatic accelerators, when the method of variable discharge is used, governed by the border insulation of the crevice through which the particles pass. (tr-auth)

RADIATION ABSORPTION AND SCATTERING

5965

SCATTERING OF ELECTRONS BY MESONS. Juan de

Oyarzabal (Universidad Nacional de México, Mexico City). *Rev. mex. fis.* 3, 76-83(1954) Apr. (In Spanish).

The interaction of electron and meson fields coupled with an electromagnetic field is calculated. From the results the cross section for the scattering of pions by electrons is determined. (J.S.R.)

5966

THEORY OF THE DIFFUSION OF X RAYS IN CRYSTALS.

PART I. J. Laval (Coll. de France, Paris). *J. phys. radi-*
um 15, 545-58(1954) July-Aug.-Sept. (In French)

After an examination of the theories of Ivar Waller and Max Born, the essential properties of elastic waves are reviewed, as well as their two modes of quantification. The two types of oscillations do not cause the same diffusion of x rays. An analytical theory of this diffusion is presented which describes the quantification of elastic waves. The diffusion of the x rays can be pictured as the result of selective reflections on the waves of electronic density, formed by the harmonic oscillations of atoms. The convergence of the series which expresses the diffusing power is determined. The data which can be obtained by measuring the permeability of a crystal are indicated. (tr-auth)

5967

RANGE AND CHARGE OF ENERGETIC NITROGEN IONS IN NICKEL. H. L. Reynolds, D. W. Scott, and A. Zucker (Oak Ridge National Lab., Tenn.). *Phys. Rev.* 95, 671-4(1954) Aug. 1.

The range of nitrogen ions in nickel was measured for energies from 8 to 29 Mev. The rate of energy loss is nearly constant over this range and has a value of 3.7 Mev/(mg/cm). The average charge of nitrogen ions in nickel was determined as a function of velocity. At a velocity of 1.93×10^8 cm/sec (27.3 Mev), the average charge is 6.2. (auth)

5968

ANGULAR DISTRIBUTION OF PHOTOELECTRONS PRODUCED BY 0.4-0.8-MEV POLARIZED PHOTONS. William H. McMaster and Frank L. Hereford (Univ. of Virginia, Charlottesville). *Phys. Rev.* 95, 723-6(1954) Aug. 1.

The angular distribution of high-energy (0.4 to 0.8 Mev) photoelectrons produced in Pb and Au foils by linearly polarized photons has been investigated using scintillation counting and pulse-height analysis techniques. A Compton-scattered photon beam from Co^{60} provided a source of partially polarized radiation. Experimental results confirm the theoretical prediction of predominate photoemission orthogonal to the electric vector of the incident photon for photoelectron energies greater than 0.5 Mev. (auth)

5969

SCATTERING OF 14.1-MEV NEUTRONS IN HELIUM, HYDROGEN, AND NITROGEN. J. R. Smith (Rice Inst., Houston Texas). *Phys. Rev.* 95, 730-5(1954) Aug. 1.

Cloud-chamber studies have been made of the scattering of 14.1-Mev neutrons in helium, hydrogen, and nitrogen. For each of these gases the angular distribution of the elastically scattered neutrons has been obtained. The angular distribution in helium shows a minimum at about 110° in the center-of-mass system, with a large maximum representing forward scattering and a smaller maximum for backscattering. The hydrogen angular distribution is isotropic. Elastic scattering in nitrogen resembles diffraction scattering, showing a strong forward scattering maximum and smaller maxima at 70° and 180° , with minima close to 60° and 130° . Inelastic scattering in nitrogen does not depart from spherical symmetry by more than a factor of two. The elastic

scattering cross section for nitrogen is 0.82 barn, and the inelastic scattering cross section for nitrogen is 0.48 barn. Cross sections for two- and three-particle disintegrations are 270 and 16 millibarns, respectively. (auth)

5970

SMALL-ANGLE CROSS SECTIONS FOR THE SCATTERING OF PROTONS BY TRITONS. Malcolm E. Ennis and Arthur Hemmendinger (Los Alamos Scientific Lab., N. M.). *Phys. Rev.* **95**, 772-5(1954) Aug. 1. (cf. NSA 7-4943).

The proton-triton differential scattering cross section has been measured for center-of-mass angles between 20 and 150° and proton energies in the range 1 to 2.55 Mev. Probable errors vary between 3 and 5 percent. (auth)

5971

EXPERIMENTS ON NUCLEON-NUCLEON SCATTERING WITH 312-MEV POLARIZED PROTONS. Owen Chamberlain, Robert Donaldson, Emilio Segrè, Robert Tripp, Clyde Wiegand, and Thomas Ypsilantis (Univ. of California, Berkeley). *Phys. Rev.* **95**, 850-1(1954) Aug. 1.

Coincidence techniques were employed to observe p-p and n-p scattering events taking place with the bombardment of deuterons by 312-Mev polarized protons. By Fourier analysis, equations for the asymmetric part of the p-p and n-p cross sections were obtained by a best fit to the data. Some conclusions on the phase shifts involved are discussed in the following letter. (K.S.)

5972

PHASE SHIFTS FOR HIGH-ENERGY NUCLEON-NUCLEON SCATTERING. Burton D. Fried (Univ. of California, Berkeley). *Phys. Rev.* **95**, 851-2(1954) Aug. 1.

Theoretical analysis of the nucleon-nucleon scattering data given in the previous letter is made by using seven phase shifts— 1S , 3S , 1P , 3P , and a single 3D . An equation for the cross sections is derived by excluding partial waves with $L > 2$, neglecting Coulomb effects and the mixing of 3S and 3D waves, and assuming the equality of triplet phase shifts and charge independence. The qualitative features of the resulting equation are not compatible with the data presented above. It is noted that the discrepancies evident in the analysis could be eliminated by introducing terms accounting for 3S and 3D mixing, and a single 3F phase shift, using a more general set of phase shifts consistent with $L \leq 2$. (K.S.)

5973

SCATTERING OF 96-MEV PROTONS FROM LIGHT NUCLEI. K. Strauch and W. F. Titus (Harvard Univ., Cambridge, Mass.). *Phys. Rev.* **95**, 854-5(1954) Aug. 1.

The scattering of 96-Mev protons by C and S is investigated. The highest energy peaks observed corresponded to elastically scattered protons, for both targets set at 40° in the lab system. The results show that "short" high-energy proton interactions can excite nuclear energy levels in a type of excitation that is different from that prevalent at low energies, i.e., compound nucleus formation. It is pointed out that such results indicate some difficulty in separating elastic and inelastic scattering events at high scattering angles. (K.S.)

5974

CHARGED PION PRODUCTION FROM CARBON BY PROTONS. Walter F. Dudziak (Univ. of California, Berkeley). *Phys. Rev.* **95**, 866(1954) Aug. 1.

A nuclear emulsion study π^+ and π^- production cross sections from C at 0 and 90° is reported, using 340-Mev protons. (K.S.)

5975

BUILD-UP MEASUREMENTS ON COBALT-60 GAMMA RADIATION IN IRON AND LEAD. C. Garrett and G. N. Whyte (National Research Council, Ottawa, Canada). *Phys. Rev.* **95**, 889-91(1954) Aug. 15.

The transmission of gamma radiation from a "point isotropic" source of cobalt-60 through iron and lead has been measured out to a thickness of approximately 15 mean free paths. The dose build-up factors derived from the observed transmissions agree satisfactorily with the calculations based on the work of the National Bureau of Standards group and carried out by the Nuclear Development Associates. (auth)

5976

PENETRATION OF 6-MEV GAMMA RAYS IN WATER. P. A. Roys, K. Shure, and J. J. Taylor (Westinghouse Electric Corp., Pittsburgh, Penna.). *Phys. Rev.* **95**, 911-12(1954) Aug. 16.

The penetration of 6-Mev gamma rays has been studied out to 190 cm in water. The dose rate has been measured with an anthracene scintillation detector as a function of the distance from the N^{16} source. The results agree closely out to 160 cm with the distribution calculated according to the theory of gamma-ray penetration as developed by Spencer and Fano. (auth)

5977

NEUTRON INELASTIC SCATTERING. Robert M. Kiehn and Clark Goodman (Massachusetts Inst. of Tech., Cambridge). *Phys. Rev.* **95**, 989-92(1954) Aug. 15. (cf. NSA-8-2673).

Neutron inelastic scattering cross sections of Fe, Al, Cr, Ni, Pb, and Bi have been measured with ~20-keV resolution for neutron energies between 0 and 2.7 Mev. A gamma-ray spectrometer measured the mono-energetic gamma rays emitted by the excited nucleus. The cross sections are in agreement with predictions based on the Hauser-Feshbach theory. The energies of the first few excited states of the stable nuclei were found to be in good agreement with values obtained by other means. (auth)

5978

GAMMA RADIATION FROM B^{10} BOMBARDED BY PROTONS. Robert B. Day and Torben Huus (California Inst. of Tech., Pasadena). *Phys. Rev.* **95**, 1003-6(1954) Aug. 15.

A sodium iodide scintillation spectrometer has been used to study the gamma radiation produced when B^{10} is bombarded by protons. The following gamma rays have been found: a 432-keV gamma ray from the $B^{10}(p, \alpha\gamma)Be^7$ reaction, a 718-keV gamma ray from inelastic scattering in B^{10} , and a high-energy gamma ray from the reaction $B^{10}(p, \gamma)C^{11}$. Excitation curves and cross sections for these gamma rays are given. (auth)

5979

$Li^7(d, p)Li^8$ YIELD CURVE. Stanley Bashkin (State Univ. of Iowa, Iowa City). *Phys. Rev.* **95**, 1012-15(1954) Aug. 15.

The absolute cross section for the $Li^7(d, p)Li^8$ reaction has been measured from 700 keV to 3.3 MeV. Previously reported resonances are located at 800 keV and 1.04 MeV, corresponding to states in Be^8 at 17.30 MeV and 17.49 MeV, respectively. A third resonance, indicated by the earlier work to be at 1.4 MeV, is not confirmed, from which it is concluded that Be^8 does not have the 17.8-Mev level for which that reported resonance was evidence. Above 1.8 MeV, the yield is relatively flat, perhaps indicating the

influence of stripping, rather than compound nucleus formation. (auth)

5980

SCATTERING OF 314-MEV POLARIZED PROTONS BY DEUTERIUM. J. Marshall, L. Marshall, D. Nagle, and W. Skolnik (Univ. of Chicago). Phys. Rev. **95**, 1020-5(1954) Aug. 15.

The polarization of deuterium for 314-Mev protons has been examined as a function of angle. A beam of 314-Mev protons about 60 percent polarized was scattered by a liquid deuterium target. Measurements were made of the asymmetry of scattering of fast protons, namely both elastically and inelastically scattered, as a function of angle. The polarization of protons by deuterons, inferred from the asymmetry, was found to be small at small angles, to be about 0.35 from 10° to 30° laboratory angle, to be zero at 45° and negative thereafter. The polarization of quasi-free proton-proton scattering measured with the two scattered protons in coincidence was found to be zero at 41° and 49° laboratory angle within statistical error. The polarization of quasi-free proton-neutron scattering was computed from measurements with the scattered proton and neutron in coincidence, and was found to be 0.56 ± 0.12 at 29° laboratory angle. The polarization of elastic scattered protons was computed from measurements using absorbers chosen to discriminate between elastic and inelastic protons, giving 0.59 ± 0.07 at 24°, 0.29 ± 0.05 at 28°, 0.39 ± 0.18 at 32°, and -0.05 ± 0.16 at 35° $\pm 4^\circ$ laboratory angle. The polarization of protons by deuterium appears to vary with angle in approximately the same way as the proton polarization of H. One can say tentatively that the polarization of protons by neutrons at this energy has the same sign and about the same magnitude. The differential cross section of deuterium for scattering of protons is given as a function of barycentric angle of the p-d system from 10 to 80 degrees. (auth)

5981

SCATTERING OF 187-MEV NEGATIVE PIONS BY HYDROGEN. Maurice Glicksman (Univ. of Chicago). Phys. Rev. **95**, 1045-7(1954) Aug. 15.

The differential cross sections for scattering of 187-Mev negative pions in hydrogen have been observed at six angles. The scattering is well represented by the angular distributions in the barycentric system: $\pi^- + p \rightarrow \pi^- + p$: $d\sigma/d\omega = 0.81 \pm 0.13 + (0.35 \pm 0.20) \cos \chi + (3.08 \pm 0.38) \cos^2 \chi \times 10^{-27} \text{ cm}^2/\text{sterad}$, $\pi^- + p \rightarrow \pi^0 + n$: $d\sigma/d\omega = 1.46 \pm 0.24 - (0.16 \pm 0.30) \cos \chi + (5.63 \pm 0.88) \cos^2 \chi \times 10^{-27} \text{ cm}^2/\text{sterad}$. A transmission measurement of the total cross section gave $63.5 \pm 1.6 \times 10^{-27} \text{ cm}^2$. An analysis of these data in terms of phase shifts is discussed. (auth)

RADIATION EFFECTS

5982

RADIATION DISARRANGEMENT OF CRYSTALS. J. S. Koehler and Frederick Seitz (Univ. of Illinois, Urbana). Z. Physik **138**, 238-45(1954) July 22.

The damage effects on crystals induced by light charged particles such as electrons, protons, deuterons, and α particles are discussed. The origin of damage in different types of solids is reviewed. The displacement effects in Ge and Cu are described. (J.S.R.)

5983

OPTICAL AND ELECTRICAL PROPERTIES OF LiF, X IRRADIATED AT -190°C . C. J. Delbecq, P. Pringsheim,

and P. H. Yuster (Argonne National Lab., Chicago). Z. Physik **138**, 266-75(1954) July 22. (In German).

The relationship which exists between the variations of the absorption spectrum, the thermoluminescence, and the electric conductivity in LiF irradiated with x rays at -190°C and their dependence on the temperature is investigated. (J.S.R.)

5984

THE METAMICT STATE. William Primak (Argonne National Lab., Lemont, Ill.). Phys. Rev. **95**, 837(1954) Aug. 15.

A number of minerals were exposed to energetic pile neutrons in an attempt to investigate the similarity of the resulting radiation damage to the metamictization of minerals, attributed to the passage of α particles emitted by contained radioactive material. Results indicate that effects associated with metamictization cannot be associated with a particular crystal structure or bond type, but rather that a quasi-stable disordered state be present under irradiation conditions. Susceptibility to metamictization is determined by the difficulty of recrystallization of the disordered regions and the difficulty with which displaced atoms can again form bonds. (K.S.)

5985

CONDUCTIVITY INDUCED IN POLYTETRAFLUOROETHYLENE BY X-RAYS. J. F. Fowler and F. T. Farmer (Royal Victoria Infirmary, Newcastle upon Tyne, England). Nature **174**, 136-7(1954) July 17.

The conductivity induced in polytetrafluorethylene by x rays was studied as a function of dose rate and temperature. The induced current i is related to the dose rate R by the expression $i \propto R^\Delta$, where Δ is a characteristic of the substance and has the value $\Delta = 0.63 \pm 0.08$ for dose rates between $R = 2$ and 65 r/min and over the temperature range 20 to 110°C . Increased temperature causes increased induced conductivity. The time constant decay of the induced current varies with temperature. (J.S.R.)

5986

RADIATION DAMAGE TO NONMETALLIC MATERIALS. V. P. Calkins (General Electric Co., Cincinnati, Ohio). NUCLEAR ENGINEERING, PART II, Chem. Eng. Progr. Symposium Ser. No. 12, 28-42(1954).

The general mechanism of radiation damage, the units used to measure the amount of radiation received, and the specific types of radiation damage involved are discussed. Service life of nuclear power plant components and methods to increase the service life are described. (L.T.W.)

RADIOACTIVITY

5987

Argonne National Lab.

ON THE ONE-BODY MODEL OF ALPHA RADIOACTIVITY. 3. NON-S-STATE DECAY, PREFORMATION FACTORS, MODEL VARIATIONS, GENERAL DISCUSSION. G. H. Winslow and O. C. Simpson. Apr. 26, 1954. 51p. Contract W-31-109-eng-38. (ANL-5277)

It is shown by direct numerical comparison that the WKB wave functions, when the variables are in the range appropriate to alpha decay, agree with the corresponding Coulomb functions to about 0.1% if $L/(L+1)$ is replaced in the former by $(L + \frac{1}{2})^2$. The correction to the potential energy for screening by the atomic electrons is discussed. The traditional one-body model and a many-body model are reviewed with the aid of general decay equations applicable

to any model having a Coulomb barrier with a vertical inside face. It is shown that a square-well one-body model with the well located at the nuclear surface has properties which might be more suitable for incorporation into alpha decay theory than those of the traditional model. A phenomenological picture of the many-body decay mechanism, to which the surface-well type of model is particularly adaptable, is found to lead to the representation of the many-body decay constant as the product of a preformation factor and a one-body decay constant. (For preceding report in series see ANL-4910.) (auth)

5988

THE NUCLIDE Al^{28} AND THE MAGIC NUMBER 14. M. E. Nahmias (Coll. de France, Paris). *J. phys. radium* 15, 568-70(1954) July-Aug.-Sept. (In French). (cf. NSA 8-4444).

It is shown that the total energy of disintegration of the nuclide Al^{28} is 4.58 ± 0.15 Mev. There exists, therefore, an anomaly of 1.4 Mev caused by a discontinuity in the packing fraction of Si^{28} in partial accord with the provisions of the shell model of Maria Mayer (Phys. Rev. 78, 16(1950)) concerning the magic number 14. (tr-auth)

5989

THE NUCLIDE Al^{29} AND THE MAGIC NUMBER 14. M. E. Nahmias (Coll. de France, Paris) and A. H. Wapstra (Laboratoire de Recherches nucléaires, Amsterdam, Netherlands). *J. phys. radium* 15, 570-2(1954) July-Aug.-Sept. (In French). (cf. NSA 8-4444).

It is shown that the total energy of disintegration of the nuclide Al^{29} is 3.97 ± 0.15 Mev. There exists an anomaly of approximately 2 Mev because of a discontinuity in the packing fraction of Si^{29} in partial agreement with Mayer's shell model (Phys. Rev. 78, 16(1950)) concerning the magic number 14. (tr-auth)

5990

THE ANGULAR CORRELATION OF THE CONVERSION ELECTRONS OF Cd^{111} . Fritz Gimmi, Ernst Heer, and Paul Scherrer (Eidgenössische Technische Hochschule, Zürich, Switzerland. *Z. Physik* 138, 394-403(1954) July 22. (In German).

A suitable source for the conversion electron correlation was developed. It was thin enough so that the scattering of the electrons could be neglected, but no effect of directional correlation by external electric fields was evident. With such a source the γ - γ , γ - e_K^- , e_K^- - γ , and e_K^- - e_K^- correlations of the Cd^{111} cascade were measured. The results showed good agreement with theory. (tr-auth)

5991

SHAPE FACTORS FOR β -DECAY. M. K. Banerjee and A. K. Saha (Inst. of Nuclear Physics, Calcutta, India). *Proc. Roy. Soc. (London)* A224, 472-87(1954) July 22.

Expressions for the shape factors of the L th degree of forbidden β transition were given by Greuling for the pure interactions and by Pursey for different mixtures of the pure forms. The same results have been derived here by a method due to Spiers and Binstoyle and formulated neatly in terms of three parameters, (a) ξ giving the spatial covariance, (b) η giving the spatial parity and (c) ζ giving the space-time parity. The results readily point out that the correct form of interaction in the β processes is either a STP combination or a VA combination. It has been concluded that the proper way of setting up the β interaction is to require that all the Dirac covariants, whose scalar products appear in the Hamiltonian, must behave in the same way under space-time reflection. A brief sketch of the principal

mathematical tools required in the method of Spiers and Binstoyle has also been given. (auth)

5992

DISINTEGRATION OF Ba^{139} . Allan C. G. Mitchell and Elizabeth Hebb (Indiana Univ., Bloomington). *Phys. Rev.* 95, 727-30(1954) Aug. 1.

The nuclear radiations from Ba^{139} have been investigated with the help of a magnetic lens spectrograph and scintillation counters in coincidence. Beta rays of energy 2.380, 2.227, and 0.822 Mev have been found together with an internal conversion line from a gamma ray of energy 0.163 Mev. The photoelectron spectrum, taken in the lens, showed gamma rays of energies 0.163 and 1.43 Mev. Beta-gamma coincidence experiments, performed with scintillation counters, showed that the 2.23-Mev beta-ray group is in coincidence with the 0.163-Mev gamma ray. The 0.163-Mev line has a $K/(L+M)$ ratio of 7.0 and an internal conversion coefficient α_K of 0.22, both of which correspond to an M1 transition. The connection with the shell model is discussed. (auth)

5993

ACTIVITIES PRODUCED IN GOLD BY PROTON BOMBARDMENT. C. H. Braden, L. D. Wyly, and E. T. Patronis, Jr. (Georgia Inst. of Tech., Atlanta). *Phys. Rev.* 95, 758-60(1954) Aug. 1.

Activities produced in gold by bombardment with 12- and 20-Mev protons were studied. Gamma rays of 1.17, 0.81, 0.58, and 0.255 Mev energy are found in the Hg fraction from the target bombarded at 20 Mev. These gamma rays all decay with a half life of 42 ± 3 hours and are ascribed to Hg^{195} produced by the $\text{Au}(p,3n)$ Hg reaction. Data concerning the decay of Hg^{197} , Au^{196} , and Au^{195} are, in most cases, consistent with previous work. (auth)

5994

BETA DECAY OF F^{20} . Calvin Wong (California Inst. of Tech., Pasadena). *Phys. Rev.* 95, 761-4(1954) Aug. 1.

The beta decay of F^{20} has been investigated with a magnetic lens spectrometer. The decay proceeds mainly to the first excited state of Ne^{20} by a beta ray of maximum energy 5.419 ± 0.013 Mev, followed by a gamma ray of energy 1.627 ± 0.005 Mev. The excited state transition, with comparative half-life $ft = 9.73 \times 10^4$ seconds, has the allowed shape down to 1 Mev. A magnetically compensated stilbene scintillation counter has been employed to show that the counts beyond the end point of the intense beta component are due predominantly to scattered electrons and room background. The direct transition to the ground state of Ne^{20} ($Q = 7.047 \pm 0.014$ Mev) is estimated to have a relative intensity of less than $\sim 3.2 \times 10^{-4}$ of the excited state transition, corresponding to a comparative half life $ft \approx 10^9$ seconds. (auth)

5995

BETA DECAY OF F^{17} AND C^{11} . Calvin Wong (California Inst. of Tech., Pasadena). *Phys. Rev.* 95, 765-6(1954) Aug. 1.

The beta decay of F^{17} and C^{11} has been investigated with a magnetic lens spectrometer. The positron spectrum of F^{17} consists of one component of maximum energy 1.748 ± 0.006 Mev. The ground-state transition, comparative half life $ft = 2420$ sec, has the allowed shape down to 570 kev. Beta-ray branching to the first excited state of O^{17} at 874 kev, if present, has a relative intensity of less than one percent, corresponding to a comparative half life $ft \approx 2 \times 10^4$ sec. The positron spectrum of C^{11} consists of one component of maximum energy 968 ± 8 kev. The ground-state transition,

comparative half life $t_{1/2} = 4170$ seconds, has the allowed shape down to 255 kev. (auth)

5996

NUCLEAR RESONANCE FLUORESCENCE IN Hg^{199} AND THE LIFETIME OF THE 411-KEV EXCITED STATE OF Hg^{199} . F. R. Metzger and W. B. Todd (Bartol Research Foundation, Swarthmore, Penna.). *Phys. Rev.* **95**, 853-4(1954) Aug. 1.

The lifetime of the 411-kev electric quadrupole transition in Hg^{199} was determined by measuring the counts from a heated source of Au^{198} , using Pb and Hg scatterers. The lifetime was found to be $(3.15 \pm 0.3) \times 10^{-11}$ sec. (K.S.)

5997

NATURAL RADIOACTIVITY OF RHENIUM. A. D. Suttle, Jr., and W. F. Libby (Univ. of Chicago). *Phys. Rev.* **95**, 866-7 (1954) Aug. 1.

A redetermination of the β energy from Re^{187} has shown that a previously reported value of 43 kev is too high. Improved measuring techniques establish an upper limit of 8 kev, and a recalculated half life of less than 10^{11} yr. Previous error is ascribed to impurity in the Al measuring foil. (K.S.)

RARE EARTHS AND RARE-EARTH COMPOUNDS

5998

ABSORPTION SPECTRUM AND SYMMETRY OF A SINGLE CRYSTAL OF EuZn NITRATE. K. H. Hellwege and W. Schröck-Vietor (Univ. of Göttingen, Germany). *Z. Physik* **138**, 449-58(1954) July 22. (In German).

The absorption spectrum of the Eu^{+3} ions in single crystals of $\text{Zn}_3\text{Eu}_2(\text{NO}_3)_{12}$ was photographed in polarized light on a 6-m grating. On the basis of orientation of the electric and magnetic dipoles assigned to the ${}^7\text{F}_0 - {}^5\text{D}_0$, $1,2$ transition the point symmetry of the layer of Eu^{+3} ions was determined to be D_4 . C_{2h}^1 was proposed as the probable space group of the monoclinic crystal. Simultaneously the value of the crystal quantum number was obtained for all term components caused by cleavage in the crystal field. From the orientation of the magnetic dipole the phases of the characteristic state of the components of ${}^5\text{D}_1$ were determined. (tr-auth)

SHIELDING

5999

THE ATTENUATION OF GAMMA RAYS AT OBLIQUE INCIDENCE. F. S. Kirn, R. J. Kennedy, and H. O. Wyckoff (National Bureau of Standards, Washington, D. C.). *Radiology* **63**, 94-104(1954) July

Attenuation data have been taken for radiation incident obliquely upon barriers of lead, concrete, or concrete-equivalent material. The gamma radiation from Co^{60} , Cs^{137} , and Au^{198} was used at angles of incidence 0, 30, 50, 60, and 70°. The results show that for oblique angles of incidence the Compton-scattered radiation may have shorter path lengths through the barrier. For the large angles of incidence, the obliquity effect must be considered in designing barrier requirements. For a diverging cone of radiation, the effect is not too significant for attenuations less than 100. It is also shown that, in the range of energies below 0.7 Mev, the addition of a layer of lead behind a low atomic number barrier can be effective in reducing the thickness requirements of the barrier. (auth)

SPECTROSCOPY

6000

ON THE SPECTRUM OF CONVERSION ELECTRONS EMITTED BY $\text{Am}^{241} \alpha - \text{Np}^{237}$. John Milsted, Salomon Rosenblum, and Manuel Valadares. *Compt. rend.* **239**, 259-61(1954) July 19. (In French).

Numerical values for the electron conversion spectra associated with the energy levels of Np^{237*} are given. (tr-auth)

6001

ISOTOPIC DISPLACEMENT IN THE Ru I-SPECTRUM. Hans Kopfermann, Andreas Steudel, and Heinz Thulke (Univ. of Heidelberg, Germany). *Z. Physik* **138**, 309-16(1954) July 22. (In German)

The Ru I-spectrum was investigated between 3850 and 5700 Å with a Fabry-Perot interferometer for isotopic displacement. Since the components belonging to the single isotopes could not be resolved, the lines were photometered and analyzed graphically. In the transition $d^4s^2 - d^4p$, $25 \times 10^3 \text{ cm}^{-1}$ appears to be the isotopic displacement between two adjacent charged isotopes ($\Delta M = 2$), in $d^4s - d^4p$, it is $14 \times 10^3 \text{ cm}^{-1}$. The isotopic displacement constant was calculated in both cases to be $\beta C_{\text{exp}} = (34 \pm 9) \times 10^{-3} \text{ cm}^{-1}$. The value fits well into the general system of the nuclear volume effects of the isotopic displacement. (J.S.R.)

THEORETICAL PHYSICS

6002

ISOTOPIC INVARIANCE OF A π -MESON FIELD. A. Baldin. *Doklady Akad. Nauk S.S.S.R.* **96**, 949-52(1954) June 11. (In Russian).

6003

PROPERTIES OF SYMMETRY IN THE THEORY OF ELEMENTARY PARTICLES AND NUCLEAR PROCESSES. I. S. Shapiro. *Uspekhi Fiz. Nauk* **53**, 7-68(1954) May. (In Russian).

A review of the properties of symmetry in the theory of elementary particles and nuclear processes is given. 62 references. (J.S.R.)

6004

ON VECTORIAL AND PSEUDOVECTORIAL FIELDS. K. H. Tzou. *J. phys. radium* **15**, 559-62(1954) July-Aug.-Sept. (In French).

The fields described by a vector or a pseudovector in which the four components, satisfying an equation of the D'Alembert type, are not submitted to any supplementary conditions were studied. Such fields, vectorial or pseudovectorial, represent a supposition of four states of spin: three with total spin of 1 and one with spin 0. The explicit separation of these states of spin is made by interactions with a spinor field by linear couplings with regard to the variables of the vectorial or pseudovectorial field. The representation of interaction, which is simple to formulate because of the absence of supplementary conditions, is introduced in the multitemporal formalism. The explicit decomposition of the spin states in this representation is made, and the representation of interaction of the vectorial and pseudovectorial fields with no divergence with a spinor field is easily deduced. (tr-auth)

6005

ON THE RELATION BETWEEN QUANTUM HYDRODYNAMICS AND CONVENTIONAL QUANTUM FIELD THEORY. F. A. Kaempffer (Univ. of British Columbia, Vancouver). *Can. J. Phys.* **32**, 530-7(1954) Aug.

The conditions are examined under which the procedure of quantum hydrodynamics would be a consequence of the conventional quantization procedure, and vice versa. Using the classical nonrelativistic theory of a charged medium as an example, it is shown that the commutation rules of the two procedures differ by a factor 2, if in accordance with an idea by Geilikman, the wave function of the classical theory is expanded as $\psi = \psi_0 + \psi_1$, with ψ_0 a constant and $\psi_1 \ll \psi_0$, and if terms of higher than second order in ψ_1 are neglected in the hydrodynamical description of the theory. (auth)

6006

THE RADIATION GREEN'S FUNCTIONS. J. G. Linhart (British Thomson-Houston Co., Ltd., Rugby, England). *J. Franklin Inst.* 258, 99-112(1954) Aug.

A method of calculating the radiation field of a group of charges by using the "radiation Green's function" is presented. The latter represents a concept similar to that of the Green's function in the potential theory, only its application is directed to the time variable problems of the radiation theory. Its usefulness is demonstrated by examples taken from the problems connected with microwave oscillators. (auth)

6007

THE SACHS EXCHANGE MOMENT. R. H. Dalitz (Cornell Univ., Ithaca, N. Y.). *Phys. Rev.* 95, 799-800(1954) Aug. 1.

A derivation of the Sachs exchange moment is given which clearly shows how this exchange moment is uniquely determined by the exchange potential. The relation between this and the treatments of Sachs and of Osborne and Foldy is discussed. (auth)

6008

PHENOMENOLOGICAL MANY-BODY EXCHANGE FORCES. L. E. H. Trainor (Queen's Univ., Kingston, Ontario, Canada). *Phys. Rev.* 95, 801-10(1954) Aug. 1.

Phenomenological many-body exchange potentials are defined in group-theoretical analogy with the usual 2-body exchange potentials of Heisenberg, Bartlett, and Majorana. The uniform model of Wigner is then extended to include many-body Wigner and Majorana forces. The theory predicts a symmetry energy between neighboring isobars of even-odd nuclei which depends upon whether the isobar of highest T_z is OE or EO, where OE signifies that the odd number of particles is greater than the even number, and EO signifies the reverse. A comparison is made with such energy differences in $T_z = 3/2$ and $1/2$ isobars, taken from β -decay data in the range $15 \leq A \leq 59$. This leads to a rough estimate of the magnitude and sign of the contribution from 3-body potentials. On this basis, the contribution from 3-body potentials is not negligible in comparison with that from 2-body potentials. (auth)

6009

TWO-BODY SYSTEM IN QUANTUM ELECTRODYNAMICS. ENERGY LEVELS OF POSITRONIUM. Thomas Fulton and Paul C. Martin (Harvard Univ., Cambridge, Mass.). *Phys. Rev.* 95, 811-22(1954) Aug. 1.

Expressions are obtained for all $\alpha^3\text{Ry}$ contributions to the energy levels of the two-fermion system in electrodynamics. These expressions are evaluated from a relativistic two-body equation which takes binding into account in its interaction operator. They are specifically calculated for the $n = 2$ levels of the system. Corrections arise from three sources: (1) improved treatment of pair effects of the Coulomb field and of the exchange of transverse photons, (2)

self-energy and vacuum polarization terms, and, in positronium, (3) second-order annihilation processes. The energy shifts resulting from (1) and (2) do not depend on the arbitrary masses through a single parameter like reduced mass. In the limit appropriate to hydrogen, the previously calculated two-body corrections of item (1) are confirmed. The principal new result is the determination of the $n = 2$ levels of positronium. In contrast to hydrogen, where the self-energy effect is dominant, here all three items yield roughly equal corrections. Together, they amount to about 3 percent of the $\alpha^2\text{Ry}$ level splitting. (auth)

6010

VALIDITY OF THE BORN-OPPENHEIMER APPROXIMATION. S. Bludman and P. B. Daltch (Yale Univ., New Haven, Conn.). *Phys. Rev.* 95, 823-30(1954) Aug. 1.

Solutions of the Schroedinger equation for several simple models in which a light particle, mass m , is bound to a heavy particle, mass M , which in turn is bound to another heavy particle which may be fixed are considered as expansions in the parameter $1/\beta \equiv (m/M)^{1/2}$. A characteristic of such systems is that when the light particle is far from the heavy particle, it centers on the mean position of the heavy particle, and when it is close to the heavy particle, it centers on the heavy particle. The classical prediction that the change in centering takes place when the motional frequencies of the light and heavy particles are equal is borne out in quantum mechanics except that here the transition takes place over an extended region as shown by the detailed investigation of models. General arguments are presented which show how low and high momenta of the light particle contribute, respectively, to centering on the mean position and on the changing position of the heavy particle. The effect of the centering on expectation values of quantities dependent on the density of the light particle at the heavy one is of the order of the ratio of an average radius of the heavy particle motion to an average radius of the light particle motion. Further corrections due to incomplete centering are of the order $1/\beta$ times this ratio. (auth)

6011

SOME PHYSICAL CONSEQUENCES OF VACUUM POLARIZATION. Leslie L. Foldy (Inst. for Theoretical Physics, Copenhagen, Denmark and Case Inst. of Tech., Cleveland, Ohio) and Erik Eriksen (Inst. for Theoretical Physics, Univ. of Copenhagen, Denmark, and Univ. of Oslo, Blindern, Norway). *Phys. Rev.* 95, 1048-51(1954) Aug. 15.

The phenomenon of vacuum polarization can be studied apart from other higher-order electrodynamic effects through its modification of the electrostatic interaction of heavy charged particles. In particular the principal deviations of the $2p-1s$ level separations from the Bohr formula in light mu-mesonic atoms ($Z \leq 6$) are expected to arise from vacuum polarization effects rather than relativistic effects (ordinary hydrogenic fine structure) or finite nuclear size. The vacuum polarization contribution to the electrostatic interaction of two protons requires slight changes in the usual analysis of proton-proton scattering data to obtain information about nuclear forces. The effect of vacuum polarization on the electrostatic energies of nuclei is also briefly discussed. (auth)

6012

SUPPRESSION OF PAIR COUPLING IN NUCLEAR FORCES. Abraham Klein (Harvard Univ., Cambridge, Mass.). *Phys. Rev.* 95, 1061-4(1954) Aug. 15.

It is demonstrated that for the nuclear force problem the

effective coupling constant for the emission of a pair of mesons is the same as the renormalized coupling constant, $g_s^2/4\pi$, which occurs in the matrix element for meson-nucleon scattering in the low energy limit. The proof involves an adaptation of the techniques developed by Deser, Thirring, and Goldberger for the scattering problem. The relatively small value of the coupling constant thus obtained, $g_s^2/4\pi \sim 1$, can be interpreted as the consequence of a net pair suppression, although not in the narrow sense associated with the nucleon propagation function alone. Radiative corrections to multiple pair vertices are considered briefly. (auth)

5013

STRUCTURE OF THE NUCLEON. II. PION-NUCLEON SCATTERING. R. G. Sachs (Univ. of Wisconsin, Madison). *Phys. Rev.* 95, 1065-78(1954) Aug. 15. (cf. NSA 6-5460).

The scattering of pions by nucleons is treated on the basis of the assumption that the nucleon has a rather complex structure consisting of a core surrounded by varying numbers of pions in certain bound states. The scattering phase shift is found to be composed additively of two parts, an orthogonality phase shift determined by the condition that the incoming wave be orthogonal to the bound field and a phase shift due to the interaction between the incoming wave and the bound field plus core. The former phase is shown to be negative at low energy and to decrease rapidly with increasing energy. The other term is found to have a typical resonance behavior. Each of the parameters appearing in the formulas for the phase shifts is given a rather direct physical interpretation. When the parameters are chosen in such a way as to give a good over-all fit to the data up to 400 Mev the following picture of the nucleon emerges: The bound field consists of P waves concentrated at a small distance ($1/4$ the pion Compton wavelength) from the core and S waves extending to about twice that distance. The states of excitation (resonances) of the bound field consist of the usual P resonance with $J = 3/2$, $I = 3/2$, and a much broader S-wave resonance with $I = 1/2$. Indications are that all other states of excitation lie higher (above 300 Mev) and are smeared out into a continuum through the emission of virtual pion pairs. (auth)

5014

APPLICATION OF THE INTERMEDIATE COUPLING THEORY TO THE SCATTERING OF PSEUDOSCALAR MESONS BY A NUCLEON. Gyo Takeda (Univ. of Wisconsin, Madison). *Phys. Rev.* 95, 1078-84(1954) Aug. 15.

Tomonaga's intermediate coupling theory is applied to the scattering of pseudoscalar mesons by a nucleon. The scattering cross section depends on the cut-off momentum of the meson field and the coupling strength between the nucleon and the meson field. For reasonable values of the coupling strength, we calculated numerically the wave function of the meson field around a nucleon. By making use of these results the scattering phase shifts are calculated for various values of the cut-off momentum. Agreement with recent experimental results is not very good, although most of the qualitative features of the experiments are reproduced. A modification of the source function of the meson field can be expected to give a better fit with the experimental results. (auth)

URANIUM AND URANIUM COMPOUNDS

5015

Argonne National Lab.

URANYL FLUORESCENCE INTENSITY AND DECAY.

Eugene Rabinowitch. July 1954. 49p. Contract W-31-109-eng-38. (ANL-5291)

The fluorescence of uranyl compounds is discussed in detail. The material presented in this report was collected for inclusion as a part of the National Nuclear Energy Series to be published later. (K.S.)

5016

THE MULTIPLICITY OF NEUTRON PRODUCTION BY SPONTANEOUS FISSION OF URANIUM. K. W. Geiger and D. C. Rose (National Research Council, Ottawa, Canada). *Can. J. Phys.* 32, 498-508(1954) Aug.

Metallic uranium was placed in a paraffin pile containing two $B^{10}F_3$ neutron counters. The mean life of thermal neutrons in this pile was measured (140 μ sec.). Neutron counter pulses occurring within a time interval of this order can be assumed to come from an individual fission event, and statistical analysis makes it possible to obtain information concerning the actual number of neutrons released in one fission event. The efficiency of the pile for neutron counting was found to be 2.5% using the known neutron rate from spontaneous fission of uranium. Without further assumption, the method does not give the mean multiplicity directly, but the higher moments of the multiplicity spectrum. A Poisson distribution for the multiplicity spectrum fits our data well and gives an average of 2.3 ± 0.2 neutrons per spontaneous fission. This value is in good agreement with the mean multiplicity from other methods. (auth)

5017

THE FISSION YIELDS OF THE STABLE AND LONG-LIVED ISOTOPES OF XENON, CESIUM, AND KRYPTON IN NEUTRON FISSION OF U^{235} . W. Fleming, R. H. Tomlinson, and H. G. Thode (McMaster Univ., Hamilton, Ontario, Canada). *Can. J. Phys.* 32, 522-9(1954) Aug.

The fission yields of Xe^{131} , Xe^{132} , Xe^{134} , Xe^{136} , Cs^{133} , Cs^{135} , Cs^{137} , Kr^{83} , Kr^{84} , 10.27-year Kr^{85} , and Kr^{86} in the neutron fission of U^{235} have been determined by mass spectrometer methods. The very pronounced fine structure in the mass yield curve in the mass range 131 to 137 found in U^{235} fission does not occur in the fission of U^{238} . This disappearance of fine structure would not have been predicted by any of the mechanisms which have been suggested to explain the fine structure in U^{235} fission. The fission yield of the 10.27-year isomer of Kr^{85} relative to the other krypton isotopes is considerably higher in U^{235} fission than in U^{238} fission. The fission yield of the 10.27-year isomer of Kr^{85} relative to the other krypton isotopes is considerably higher in U^{235} fission than in U^{238} fission, indicating some fine structure in this mass range which may be related to the closed shell of 50 neutrons. (auth)

5018

FINE STRUCTURE IN U^{233} FISSION. E. P. Steinberg, L. E. Glendenium, M. G. Inghram, and R. J. Hayden (Argonne National Lab., Lemont, Ill.). *Phys. Rev.* 95, 867-8(1954) Aug. 1.

Fine structure in the slow-neutron-induced fission of U^{233} is indicated in the region near mass number 99 and is consistent with the interpretation of preferential fission complementary to heavy fission products containing 82 neutrons around mass number 133. A dip in the U^{233} yield-mass curve is apparent at mass numbers 91 and 92, similar to the fine structure already observed in the fission of U^{235} . Analogous effects are noted in the spontaneous fission of Cm^{242} . (K.S.)

PATENTS

CHEMISTRY

6019

RECOVERY OF HEAVY WATER FROM REACTED SOLUTIONS THEREOF. C. F. Hiskey (to U. S. Atomic Energy Commission). U. S. Patent 2,681,883, June 22, 1954.

The recovery of heavy water from solutions or slurries of uranium compositions and heavy water, used as the reactive composition in a nuclear reactor, is described. The method of recovering heavy water from a solution of heavy water and uranyl fluoride is by distillation of the heavy water in the presence of uranium trioxide.

6020

ISOLATION OF FLAVONOID COMPOUNDS. S. H. Wender (to U. S. Atomic Energy Commission). U. S. Patent 2,681,907, June 22, 1954.

The method of purifying flavonoids, wherein pure flavonoids, may be separated in relatively concentrated form from extraneous organic and inorganic impurities, consists of treating a water extract of the flavonoids with a cation-exchange resin, separating the resulting flavonoid-depleted water extract from the resulting flavonoid-retaining resin, and eluting the flavonoids retained by the resin with an organic solvent.

6021

COMPOUNDS OF THE ELEMENT AMERICIUM. L. B. Asprey, R. A. Penneman, and S. E. Stephanou (to U. S. Atomic Energy Commission). U. S. Patent 2,681,923, June 22, 1954.

Compounds of a new valence state of the element americium have been prepared. The process comprises treating americium of oxidation state less than six in a solution of about 0.3 molar perchloric acid with excess of a soluble peroxydisulfate, whereby americium is obtained in an oxidation state of six, adding sodium acetate to the solution, whereby insoluble sodium americyl acetate is formed, and recovering the precipitated sodium americyl acetate.

6022

STILL. R. J. Schmidt and S. Rosenfeld (to U. S. Atomic Energy Commission). U. S. Patent 2,682,451, June 29, 1954.

A distillation apparatus particularly useful in conjunction with the production and purification of chlorides of uranium is described.

6023

EXTRACTION APPARATUS. L. Wainwright (to U. S. Atomic Energy Commission). U. S. Patent 2,682,452, June 29, 1954.

The apparatus continuously brings into contact and separates two liquids, at least partially immiscible with each other and of different specific gravities, by countercurrent extraction. The purpose is to provide a multi-stage countercurrent extraction apparatus in which the most intimate contact is obtained between the solvent and the solution to attain equilibrium rapidly and yet in which there are no moving parts other than ordinary liquid pumps.

6024

SEPARATION OF AMERICIUM AND CURIUM FROM AQUEOUS SOLUTIONS. D. F. Peppard and P. R. Gray (to U. S. Atomic Energy Commission). U. S. Patent 2,683,655, July 13, 1954.

The process comprises contacting an aqueous concentrated nitric acid medium and a substantially water-im-

miscible alkyl phosphate medium, at least one of the media containing americium and curium in solution, whereby curium values are preferentially held by the alkyl phosphate medium while americium values are preferentially held by the aqueous medium, and separating an alkyl phosphate phase from an aqueous phase.

6025

PROCESS FOR PREPARING BORON. J. S. Spevack (to U. S. Atomic Energy Commission). U. S. Patent 2,685,501, Aug. 3, 1954.

The process for preparing boron by the reduction of a boron halide with alkali metal comprises forming a fine dispersion of molten alkali metal in a gaseous medium and reacting the dispersed alkali metal with the boron halide at an elevated temperature.

ENGINEERING

6026

ELECTRONIC CONTROLLED PUMPING SYSTEM. D. S. Schover (to U. S. Atomic Energy Commission). U. S. Patent 2,682,364, June 29, 1954.

An electronic controlled gas pumping system of the Toepler type wherein electronic means are provided for alternately evacuating and applying pressure to the fluid pumping means is described.

6027

SHOCK OR VIBRATION ISOLATING MEANS. E. K. Arnold, D. W. Laviana, and G. L. Cooper (to U. S. Atomic Energy Commission). U. S. Patent 2,684,825, July 27, 1954.

The apparatus comprises a combination of steel springs and variable rate silicone springs in parallel to achieve isolation and protection at extreme high and low temperatures and regardless of the positioning or attitude of the moving system.

PHYSICS

6028

POLAROSCOPE. Q. A. Kerns (to U. S. Atomic Energy Commission). U. S. Patent 2,680,227, June 1, 1954.

An apparatus for electrochemical analysis of electrolytic solutions is described which automatically produces a visual polarogram during a predetermined fraction of the interval between birth of a new mercury drop and of the breaking off of the drop at the tip of a capillary electrode.

6029

NEUTRON SCINTILLATION COUNTER. B. W. Thompson (to U. S. Atomic Energy Commission). U. S. Patent 2,681,416, June 15, 1954.

An instrument and method for detecting neutrons utilizing scintillation material and light-detecting apparatus are described. The detector comprises a spherical metallic housing which is opaque to light and charged particles and substantially transparent to neutrons, having a thin layer of hydrogenous material disposed on the inner surface of a housing whereby neutrons are captured and protons released, and a thin layer of proton-sensitive fluorescent material disposed on the inner surface of the hydrogenous material which emits light detected by a photomultiplier tube.

6030

SHIPPING CONTAINER FOR RADIOACTIVE MATERIAL. M. B. Hawkins and E. R. Tompkins (to U. S. Atomic Energy Commission). U. S. Patent 2,682,352, June 29, 1954.

The container can have a dust-tight sealed cap to prevent the escape of radioactive materials from the can while permitting the escape of gases which may be produced during the neutron treatment. The container is further provided with means for shearing the cap to facilitate the removal of the contained radioactive material.

6031

GAMMA AND X-RAY DOSIMETRIC METHOD. G. V. Taplin and C. H. Douglas (to U. S. Atomic Energy Commission). U. S. Patent 2,682,510, June 29, 1954.

A colorimetric dosimeter for the measurement of x or gamma radiation is described. It has been found that by providing a suitable two-phase system comprising an aqueous dye solution on contact with a low-molecular weight chlorinated hydrocarbon, a stable, reliable, radiation-sensitive system is obtained which indicates exposure to predetermined quantities of x or gamma radiation by undergoing a color change.

6032

CONTACTING DEVICE. F. R. Shonka and R. F. Selman (to U. S. Atomic Energy Commission). U. S. Patent 2,682,583, June 29, 1954.

Electrical switches which are adapted to be used in radiation dosimeters, eliminating the electrical leakage caused by physically separating an electrode of the ionization chamber from its terminal on the outer surface of the casing of the dosimeter, are described. This is accomplished entirely within a sealed moistureproof chamber by means of a magnetic switch, thus providing a highly precise instrument for the measurement of radiation.

6033

ION SOURCE. W. M. Woodward and L. G. Smith (to U. S. Atomic Energy Commission). U. S. Patent 2,682,611, June 29, 1954.

The apparatus produces a continuous supply of ions of metals and the compounds of metals such as copper, cobalt, or uranium, or the halides of such metals, for use in the ionic separation of the isotopes of such source metals. There is provided apparatus for automatically and intermittently feeding a predetermined quantity of ionizable material onto the anode in an ion generator.

6034

CONTROL ROD DRIVE MECHANISM. B. C. Cerutti and H. V. Lidtenberger (to U. S. Atomic Energy Commission). U. S. Patent 2,682,785, July 6, 1954.

The device permits the slow withdrawal of a safety rod from the active portion of the reactor to allow the control elements of the reactor to gain control and also permit the rapid insertion of the rods into the reactor if it becomes necessary to prevent a runaway.

6035

PARTICLE AND GAMMA RAY ENERGY SPECTROMETER. B. R. Gossick (to U. S. Atomic Energy Commission). U. S. Patent 2,683,221, July 6, 1954.

The apparatus for investigating the energy spectrum of a beam of neutrons or other radiations comprises a proportional counter in combination with means for producing a collimated beam of neutrons, a solid hydrogenous radiator, and a linear pulse amplifier biased to count only very large pulses.

6036

RADIATION METER. G. Failla and H. H. Rossi (to U. S.

Atomic Energy Commission). U. S. Patent 2,683,222, July 6, 1954.

A simple, inexpensive radiation meter requiring no auxiliary power supply is described. The device may be small enough to be worn as a ring or may be relatively large to obtain greater sensitivity. The meter comprises in part a radiation permeable container enclosing a conducting element, an ionizable gas in the container, radioactive means for changing the charge on the element, shielding means to prevent the radioactive means from acting on the ionizable gas, and means for detecting change in the charge on the element when the device is exposed to exterior radiation.

6037

SHIELDING WINDOW AGAINST RADIOACTIVITY AND COMPOSITION THEREFOR. W. B. Doe (to U. S. Atomic Energy Commission). U. S. Patent 2,683,650, July 13, 1954.

An improved and stabilized liquid composition useful in a transparent shielding window has been prepared. Stabilization of an aqueous concentrated solution of commercial zinc bromide against deterioration and discoloration in the presence of intense gamma radiation for a long period of time is obtained by adding hydroxylamine hydrochloride to a concentration of about 0.9 molar.

6038

VARIABLE VOLTAGE WAVE FROM GENERATOR. G. D. Paxson (to U. S. Atomic Energy Commission). U. S. Patent 2,683,807, July 13, 1954.

An electronic circuit for generating a voltage waveform having a plurality of variable voltage points which may be varied independently without disturbing the value of the voltage at other points of adjustment of the waveform is described.

6039

ION BEAM MEASURING DEVICE. R. L. Mather (to U. S. Atomic Energy Commission). U. S. Patent 2,683,814, July 13, 1954.

An ion beam energy measuring device and determination of the angle of emission of secondary radiation generated by the bombarding beam are described. The angle of emission of the secondary radiation generated is a function of the energy of the bombarding beam, which may be determined thereby.

6040

RADIOACTIVITY MEASUREMENT. L. W. Alvarez (to U. S. Atomic Energy Commission). U. S. Patent 2,685,027, July 27, 1954.

A method and means for measuring and analyzing radioactivity which decays rapidly are reported. The irradiated samples are placed in a counter, pulses from which and timing pulses $\frac{1}{4}$ second apart are amplified and fed into a coil. The pulses are transferred as magnetic domains on a wire passing through the magnetic circuit of the coil. The wire is wound on a reel and may be played back to obtain data for determining the decay rate.

6041

RESONANT TYPE SHAKE TABLE. D. M. Ellett and W. E. Baker (to U. S. Atomic Energy Commission). U. S. Patent 2,686,427, Aug. 17, 1954.

An adjustable frequency shake table capable of large excursions with small input energies is described. The table is caused to vibrate by an electromagnetic motor, the energization of which is adjustable in frequency.

6042

WATER COOLED INSULATOR. B. H. Roffee (to U. S. Atomic Energy Commission). U. S. Patent 2,686,827, Aug. 17, 1954.

The improved insulator designed for severe service is provided with a depression at one or both ends and fitted with means to flow a cooling medium therethrough.

6043

ISOTOPE SEPARATOR. W. E. Glenn, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 2,686,880, Aug. 17, 1954.

The improved time-of-flight isotope separator of the linear type comprises, in part, ion generating means, electric field means for linearly accelerating the ions, and electrostatic deflecting means for collecting the separated ions. The apparatus is quite sensitive and compact.

